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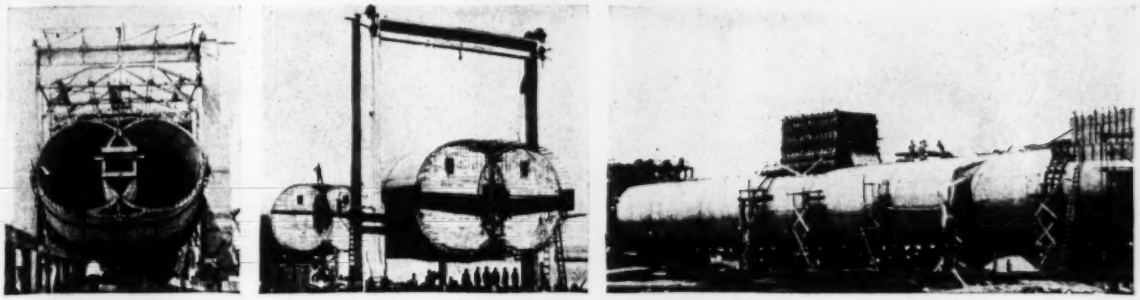
August 26, 1920

Engineering News-Record



Steps in Building Cast Concrete Oil Tanker

Concrete Tanker Built of Separately Cast Cylinders

Radical Design in Which Two Interlocked Cylinders are Poured Upright, Turned Horizontally and Joined to Form Hull of 2000-Ton Oil Carrying Vessel

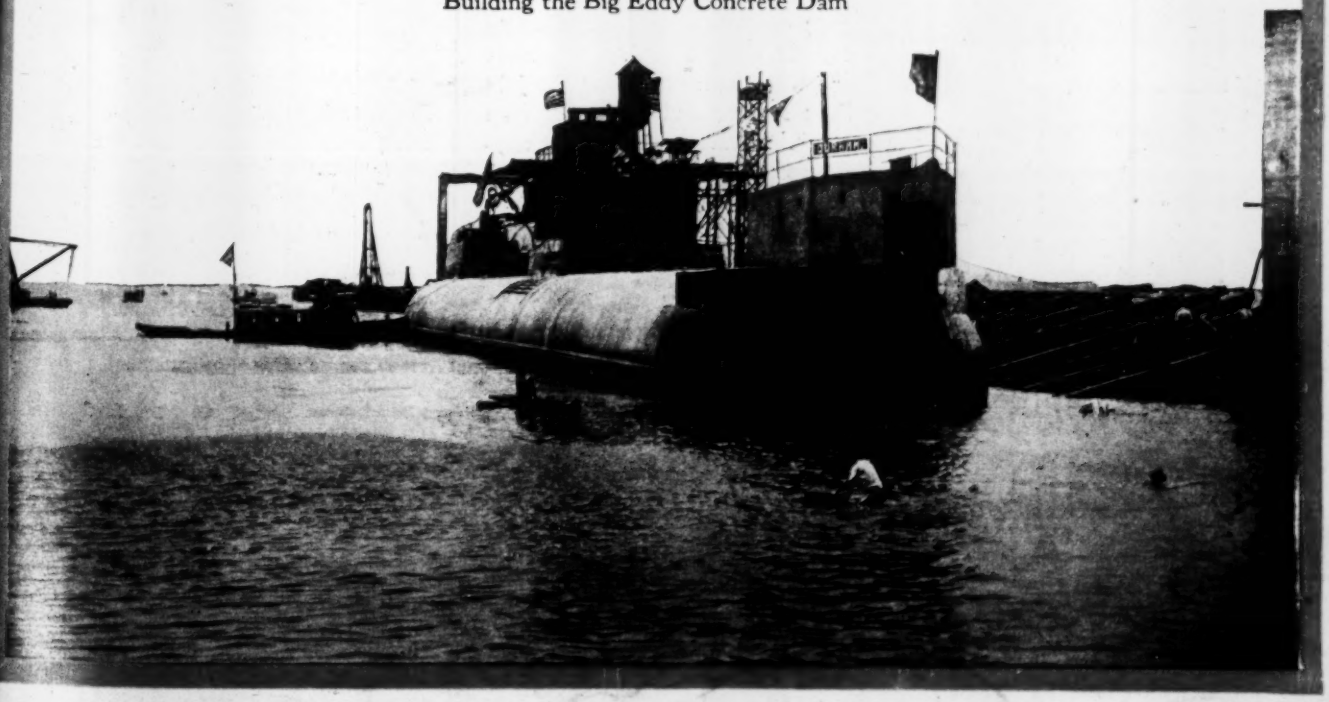
Other Articles in This Issue:

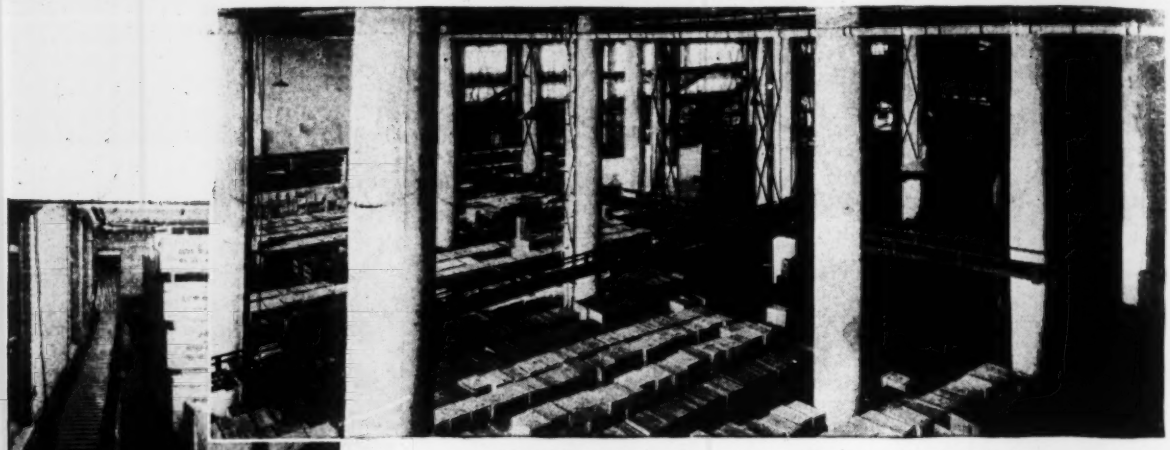
French Government to Regulate River Rhone
By Thorndike Saville

New Mechanical Trimmers of the B. & O. R. R.
By Philip G. Lang, Jr.

Repeated Stress Safety Factors Quickly Determined
By J. B. Kommers

Building the Big Eddy Concrete Dam





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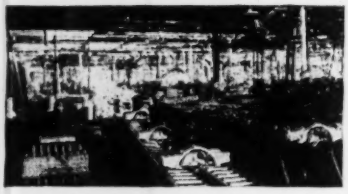

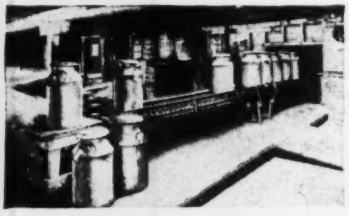

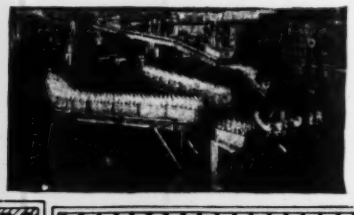

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 85 — NEW YORK, THURSDAY, AUGUST 26, 1920 — Number 9

Motor Vehicle Increase

THE increase in motor vehicles from 1 in 2,000 to 1 in 15 of population from 1906 to 1919, shown in detail on p. 299 of our issue of Aug. 12, illustrates the great problem that has confronted the highway engineer. It is a continuing but changing problem. The motor-vehicle saturation point has not been reached but the rate of increase of passenger vehicles will decline and that of motor trucks—now the chief concern of the road engineer—will rise. Assuredly there is need for searching study of highway design, as well as of bridges in relation to motor trucks. The last-named subject is discussed at some length on a following page.

Facilitating City Contracts at Detroit

ADOPTION by a special commission of a "sliding scale" contract form recommended to the Detroit Common Council as a means of speeding work upon that city's $50,000,000 sewer construction program was noted on p. 349 of our issue of Aug. 19. It is hoped that the new contract form, which at least minimizes the material price and wage risk encountered in current bidding, will re-awaken the interest of contractors in sewer work at Detroit, which has lagged until recently and not more than 25 per cent progress was being made upon the program mapped out by the Commissioner of Public Works. Though designed specifically for sewer work its proponents claim for the contract applicability to all forms of municipal improvement. Municipalities in general will await with interest the effect upon bidders of such a contract.

Parochialism Personified

THAT part of the country lying west of the Hudson does not appreciate the extent to which New York's expensive port levies tribute on the country at large. Constant reference, then, to the insularity of the officials of the city is worth while. In time national public opinion may begin to have some effect on New York's politicians, who, it is only fair to say, are backed up by a large part of the commercial interests of the city. The latest official outburst is from President La Guardia, of the Board of Aldermen, one of the two republican members of an administration under democratic control. In praising the prospect of new piers replacing some ancient ones on the North River he said: "I believe that after these eighteen new piers have been completed and the Staten Island water-front development carried through and Jamaica Bay made a great water terminal the port of New York need not worry about what New Jersey does. In fact, with these improvements accomplished, New Jersey will be at our mercy." And if New Jersey, of course, the rest of the country. The tremendous costs of lightering non-local freight will continue because of the narrowness of those guiding New York's destinies.

Standardizing Building Codes

A FEW weeks ago we commented on the absurdity of the variations in moment coefficients in flat-slab design in the building codes of the country (see Aug. 12, p. 289). This is only one example of the lack of uniformity in such codes, which represent the taste and fancy of their framers to an extent not at all warranted by the variations in knowledge of the physical facts these codes reduce to practice. In an effort to standardize such regulations the National Federation of Construction Industries is now engaged in the worthy task of tabulating the provision of the principal codes of the country. After the tabulation is made the federation will enter upon a campaign of education, not, it says, to determine the proper provisions but to give building officials a bird's-eye view of the situation so that they may realize the divergences now existing. It is hoped that merely calling attention to differences may tend to reduce them in such revisions as are continually being made.

Utilizing the Army Ports

NEARLY two years have elapsed since the armistice and nothing has been done toward utilizing for overseas shipments the port terminals, which were not completed in time to be of military service. Many of the war structures have had to be scrapped and their cost charged up to the general losses of war. Such should not be the case with the terminals. Their design was made primarily for military purposes but some of them at least are singularly adapted for the commercial needs of the ports where they are located. Terminal design in this country has been notoriously backward. To many the war terminals seemed a step in advance, but their real utility can only be gaged by their performance. Surely the War Department should be able now to release most of them for commercial use and should furthermore be able to arrange some workable scheme for their being taken over by private or public interests. A committee investigated their disposition some months ago. Why does not the department take some action?

Something New in Ships

IT IS safe to say that no structure of sizable proportions developed by the war showed such striking originality of design as the articulated concrete tankers described on another page of this issue. The large concrete ship was really a product of the war, though in Sweden practice was slowly leading up to it. With the exception of the Macdonald tankers, however, the concrete ship was an orderly development of the steel ship—the reproduction of a standard type in another material with only such change as the properties of the new material demanded. The Government, which prac-

tically controlled all shipbuilding, was not disposed to go further into unexplored fields than seemed absolutely necessary. Such conservatism did not hamper the builders of the cylinder tankers; in fact, their project left conservatism far behind and ventured well into boldness. The proof of their success will be in the behavior of the vessels, but the average concrete engineer will look with some misgivings at the longitudinal strength of the joints between the new and old concrete. Aside from that danger, the extent of which will doubtless be considered by the designers in an expected early article, the conception of construction is admirable and has seemingly worked out well. The engineers responsible for the tankers have certainly given the engineering world something new.

Wider Use of Railway Standards

THAT present conditions of economics and finance will tend to enforce the wider adoption of standards of design and practice in railway service is the opinion of Charles A. Morse, chief engineer of the Chicago, Rock Island & Pacific R.R., as expressed in a statement quoted on page 395. Although Mr. Morse refers to the standards of but one society, it may be pointed out that several technical societies have for years past had committees which spend time and energy in devising standard designs and recommended methods of practice. Here again there is possibility of conflict between the standards of different societies and it appears that those of but one should prevail in general adoption. The introduction of these standard designs and methods, though urged by the societies, is so slow and limited that the fullest advantage from universal use is not even approached. Three causes for this may be cited: Indifference or inertia, a prejudice or preference for present individual practice, and a failure to see the economic advantages of the recommended practice in relation to the railway system as a whole. Immediate personal or local trouble that may arise from a change to new and improved methods is apt to be seen much more clearly than the ultimate economy and benefit to the individual road and to the railways in general. In Mr. Morse's opinion, coming development will be a spur to action in this respect. It may be suggested that good judgment will counsel action before spurring becomes necessary.

Changing Conceptions of Refuse Disposal

THAT time brings changes the world over is illustrated by refuse disposal in England. While it never was as true as popularly conceived in this country that all city refuse in England is burned in destructors, nevertheless for decades it was the accepted theory and to a large extent the practice there. The war there, as here, made it necessary to conserve all possible municipal waste, and there, as here, it is likely that much of this conservation will be continued. At a recent meeting of "cleansing" superintendents at Sheffield, a speaker, according to the London *Surveyor* of June 25, "advocated the combination of the destructor with an efficient system of salvage." The *Surveyor* says: "We are disposed to agree with his contention that the destructor is by no means yet out of date. But the day is rapidly passing when the indiscriminate destruction of all the contents of refuse bins will be regarded as the ideal at which to aim."

Garbage reduction has never gained a foothold in England, but some of the garbage was utilized in one way or another before the war, while during the war considerable garbage was fed to hogs, though apparently by relatively small municipalities. Sorting out paper and other salable material from refuse has long been practiced in England. Today, it appears that the United States is far ahead of Great Britain in the matter of utilizing garbage, if not also in sorting and reclaiming refuse. The great American advance in this particular during and since the war has been in feeding garbage to hogs, now practiced by a number of large cities. There is ample opportunity for further advance along this line and also in the field of refuse sorting and utilization.

For some months past New York City has presented an example of changing conceptions in another direction. It has caused the shutdown of a garbage utilization plant operated by a contractor who paid the city large sums a year for the garbage and has been reverting to the wasteful and otherwise objectionable practice of dumping garbage at sea. It is high time that this was changed, but there seems to be little likelihood of change, or at least rational change, under the present city administration.

Highway Bridges and Motor Trucks

FIVE years ago there were about 70,000 commercial motor vehicles on our roads. Today there are 700,000. During the tenfold increase since 1915, the motor truck has penetrated everywhere, and instead of frequenting only the main highways it now seeks out every road, even the most remote. Except in a few states it travels without restriction as to load and speed. A truck weighing ten, fifteen or twenty tons is free to pound its way along any country road and over dozens of bridges, small and large, that were not built to carry such loads or resist such violent impacts. A condition of danger is being created for us, almost unsuspected.

Already there is a disturbing frequency of failures of highway bridges under motor trucks. Statistics of these failures do not exist, but we risk little in saying that they are increasing in number. A typical press clipping reads: "A drawbridge on the state highway between —— and —— collapsed today, dropping a four-ton truck into the water. Governor ——, who is on a motor tour of the state, was to have passed over the bridge about the time the collapse occurred but he was advised of the break and directed to reach this city by detour." Many such occurrences do not get into the newspapers, however. An engineer writes of two floorbeam failures in bridges near his town, where because of the absence of serious results no press report was published. As a matter of fact these failures are even more significant than those involving complete collapse, for the most dangerous weakness against concentrated loads is to be found in floor systems, not in main girders, and therefore when floors are broken through by the increasing traffic loads the result is to be regarded as the inevitable outcome of the conditions that have been allowed to develop. Accident may play a part in some bridge failures and make them interesting objects for engineering investigation, but the occurrence of floor failures and the breaking down of small bridge spans under motor trucks

is a simple indictment of weak bridges and excessive, unregulated, traffic loads.

How inadequate is the strength of existing bridges was well brought out in a survey of bridge capacities made during the war by a state highway department for military purposes. The survey covered all road bridges in the state, including those under township and county control. Briefly summarized, it showed that many of them could not carry more than a one-ton load without exceeding the usually accepted limits of safe stress; only a small percentage of all could carry a five-ton truck. There is no reason for thinking that other states are in better condition. This is startling when we consider that the truck-building industry has its center of gravity in the field of trucks of 2 to 2½ tons capacity, vehicles whose gross weight often exceeds five tons, while at the same time there is a steady increase in the number of much heavier trucks, with gross weights frequently of 12 to 15 tons and more.

That heavy truck loading plays a controlling part in the matter, now that motor trucks are traversing all the byroads, is reflected in the statement made to us by an engineer that recently, while looking at a fifty-year-old bridge, a serviceable and well preserved structure, he learned that a truck carrying twelve tons of freight had crossed it a few days previously. The bridge was not designed for loads even approaching this; droves of cattle and possibly a light road roller were the heaviest loads that the bridge engineer had to consider in former years. Relatively high wheel loads occur even under trucks of moderate capacity, a point well brought out by figures of actual truck wheel loads obtained from authentic sources, given by an investigator of the subject in our issue of June 27, 1918, p. 1228. But frequently the loading of trucks goes far beyond rating limits, and the figures quoted are doubtless much below the facts of road service.

It is quite obvious that the chances of the conjunction of heavy load and light bridge are each day becoming greater, in perilous degree. Thousands of bridges, even tens of thousands, are creating a menace through their own weakness and the increasing frequency and ubiquity of heavy motor truck loads passing along the roads in rapid flight. Not only direct load effects are concerned, but shocks and blows of unknown amount are set up by the fast-moving vehicles crossing over rough floor surfaces, so that we cannot even determine in a reliable way how close we are to the danger point.

Until it may be possible to rebuild all bridges that are now too weak, safety can be found only through regulation of bridge use on the one hand, and control of maximum loads and speeds on the other. By posting every bridge in the country for its capacity, and taking steps to see that loads greater than the posted capacity do not cross the bridge, a very large degree of protection can be obtained. Limitation of maximum truck loads, and control of speeds of travel, will increase this protection. The necessity for such protection has been made imperative by the great increase in number of trucks.

State highways departments, it is fair to say, have recognized the existence of the bridge problem for a number of years; certainly their bridge engineers have been well aware of conditions. But the departments have been utterly submerged in their road construction problems. Charged with the duty of applying vast sums of current expenditure appropriated to pavement construction, confronted by problems that momentarily, at least, are bigger than our resources, they have lost sight of the bridge question while wrestling with the difficulties of deciding what pavement to use and how to put it down. From the pavement standpoint, however, limitation of truck loading is a problem that will bear delay. Too rapid wearing out of pavement may be costly, but it is not a matter of life, of public safety. The failure of bridges is of very different kind; a single load can destroy a bridge. Such a condition can not be left to work itself out at leisure. For the time being, the bridge problem must take precedence over the pavement problem in spite of the much greater magnitude of the latter.

Division of authority and responsibility has played a part in bringing the problem to its present urgency. States control only the bridges on main roads, and the outstanding danger arises from the bridges on town and county roads. Nevertheless the state is clearly the authority through which relief must be sought. Both limitation of truck loads and speeds by law and the posting of bridge capacities can only be brought about by state action. To secure legislative action to this end, the state highway departments may well take the initiative. Engineering sentiment will support them in advocating the necessary laws.

However, not only the preservation of old bridges but also the design of new ones is involved, and here the state is directly interested. At present no one can forecast what future highway loadings may be, since the industry is still permitted to develop in a quite unregulated way. In the design of new structures on main roads, therefore, guessing at maximum loads is involved just as obviously as it was in the design of the bridges of fifty years ago. The designer of a new highway bridge may well be pardoned if he contents himself with load assumptions chosen at random for in any event he has no recourse but to let developments come as they will, and live in the faith that his bridge may have a reasonable length of life before increase of load makes it obsolete. But if the loads and speed can be regulated now his design will be much more closely suited to the service requirements it must meet, and waste of money thus avoided.

What the present moment demands is that steps be taken at the earliest possible moment, in every state of the Union, to fix truck load limits and if possible limits of their speed. Time is lacking to delay action until a nationwide understanding can be obtained as to what these limits should be. Nor is it important to secure harmony at the start, for after local action has been secured everywhere it will be time enough to set about harmonizing the individual requirements. At the same time that load limits are fixed locally, it is important that laws be passed requiring the posting of all bridges and putting severe discouragements on attemps to disregard the posted limits.

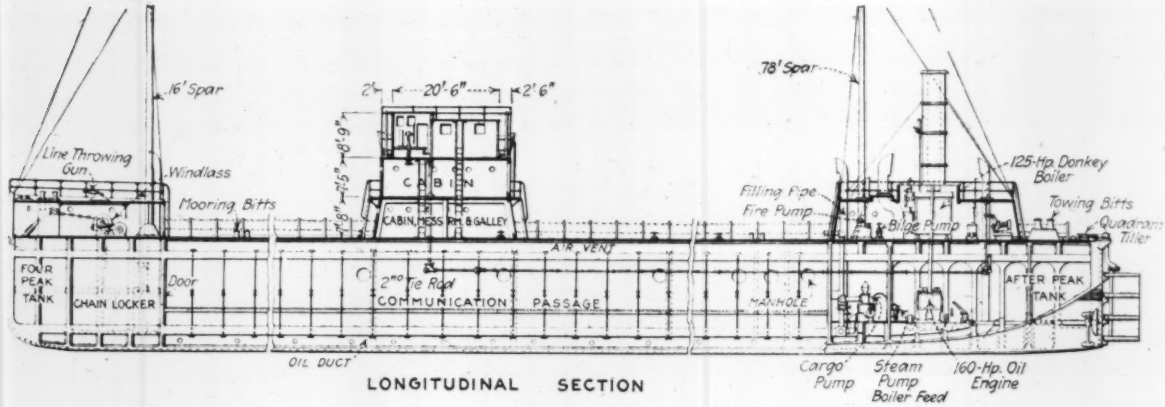
With such preparation, the slow and difficult task of bridge revision can be taken in hand on the basis of the load limits set by law. This part of the work, however, will be bound to take a number of years at best, and can be of no service for protection at the present or in the immediate future. Ultimately we will have both stronger bridges and controlled truck practice; for the present the way to safety must lie through regulation alone.

Concrete Tanker Built of Separately Cast Cylinders

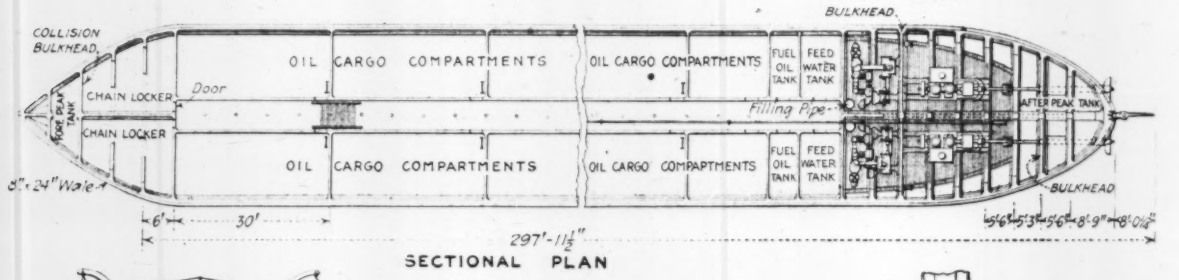
Sections of Two Interlocked Cylinders Poured Upright on Platform and Turned Horizontally To Be Joined Together To Make 2,000-Ton Oil Carrying Self-Propelled Vessel

ON July 24, 1920, there was launched at Aransas Pass, Tex., the first of two reinforced-concrete oil tankers of most radical design. Projected just before the end of the war they were well progressing when the hurricane of September, 1919, wrecked the yard and delayed completion of the vessels. One of the two ships is now ready for a trial trip and the other will be launched in a short time. These boats, of approximately 2,000-ton deadweight capacity and nearly 300 ft. long, are made up of nine separate sections, cast separately and joined together in place on a long launching way. Of those sections seven are of identical construction, being of double circular shape and cast upright and turned to a horizontal position. The bow is poured separately and moved to its proper location, while the stern is poured in place.

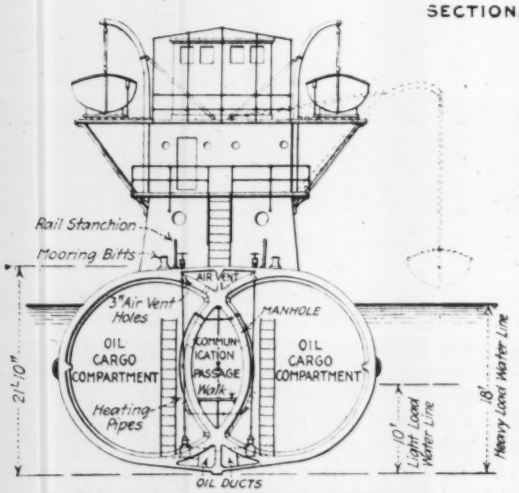
Details of the design of these remarkable vessels will appear in an early issue of this journal. There are presented here a series of views of their construction and an outline of the methods used, both furnished by



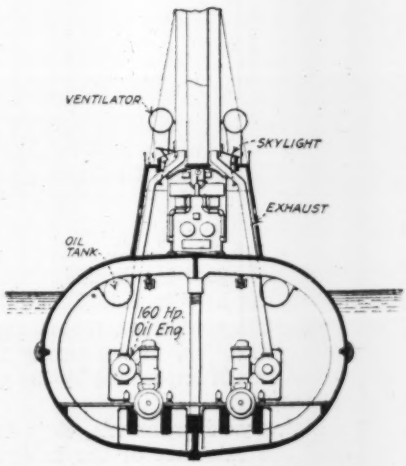
LONGITUDINAL SECTION



SECTIONAL PLAN



SECTION THROUGH CARGO COMPARTMENT AND ELEVATION OF CABINS AND WHEEL HOUSE (Looking Aft)



SECTION THROUGH ENGINE COMPARTMENTS, STERN DECK HOUSE AND SMOKE STACK (Looking Aft)

CONCRETE TANK STEAMER 300 FOOT LONG, BUILT OF SEPARATELY CAST CYLINDERS

the Macdonald Engineering Co., Chicago, which designed and built the tankers.

During the latter months of the war T. E. Byrnes, president of the France & Canada Oil Transport Co., New York, secured permission from the Emergency Fleet Corporation to construct at Aransas Pass, Tex., a fleet of reinforced-concrete ocean-going barges for transporting oil from Tampico to Aransas Pass. After consideration of many designs it was decided to construct these vessels in accordance with proposals put forward by the Macdonald Engineering Co., along lines which though radical promised economy in construction and efficiency in operation.

The vessel consists of two interlocking cylinders, so spaced as to make the relation between beam and depth dimensions approximately the same as is usual in vessels of standard type. The interlocking of the cylinders provides along the midship line of the vessel a buoyancy chamber extending the entire length of the cargo space, and this chamber also serves as a passageway from bow to stern. The main portion of the cylinder on each side of the buoyancy chamber is cargo space for oil; the smaller chambers at the bottom serve as ducts connecting the oil compartments with the cargo pumps; and the similar chambers just below the deck act as relief pipes, carrying air from the cargo compartments to ventilators at the bow and stern.

The ship is 298 ft. long overall, 33 ft. 9 in. beam and 21 ft. 10 in. deep. It will have a deadweight cargo capacity of approximately 2,000 tons, or 14,000 barrels of medium oil. Transverse bulkheads are spaced 30 ft. apart, each vessel thus containing seven compartments on each side of the buoyancy chamber, or a total of fourteen.

A few weeks after the contract for these vessels was placed the war ceased and propelling equipment, not previously obtainable, could be secured. It was therefore decided to make the tankers self-propelled, using internal combustion engines. The stern section was redesigned to provide engine space, and other necessary alterations were made to meet the changed program.

It will be noticed that the vessel is built without transverse frames. This feature was an essential part of the method of construction proposed by the builders and followed out in the work. Each section 30-ft. long was built on end by the use of sliding forms raised continuously night and day by patented jacks—a method of building developed by the constructors in their long experience in concrete grain elevator work. This manner of working produces concrete more free from joints or lines of cleavage than any other method, and is also very fast in practice. For instance one section—26 ft. 10 in. of actual depth of concrete—was run in 28 continuous hours.

By employing sliding forms and raising them free of the concrete work as the section was finished the same forms could be lowered to their original place again and used for building similar sections for an indefinite number of ships. This duplication it was thought would effect great economies in construction.

The use of the sliding form makes the simultaneous construction of ribs or other offsets impossible. The transverse strength of the ship section therefore depends on arch action. The arch is under unsymmetrical hydrostatic loading, the lower end of the arch, nearest the keel of the vessel, being subjected to the maximum pressure, while the upper end is under less stress. Calculations of the arch were made for conditions both light and fully loaded, and with extreme valley and crest assumptions for waves. The results called for a thickness of concrete of 10 in. at the bottom end of the arch and 7 in. at the top end. The outer skin, therefore, is of a thickness showing a gradual increase from 7 to 10 in. with modifications along the buoyancy chamber, air and oil ducts, and the deck and bottom structure. In considering this thickness it must be remembered that there are no ribs, so that what would appear an excessive skin thickness in a concrete ship of standard construction must be viewed in the light of the frame omission. Furthermore, as the vessel was of frankly experimental design it was not thought wise to take chances, leaving any lightening of weight to the dictates of experience in actual service.

The bow section, 30 ft. long, and the stern section, 52 ft. long, being ship shape rather than parallel sided, were necessarily built in fixed forms, arranged for sliding apart to permit duplicating the concrete work for the next ship.

The sequence of construction was as follows:

A reinforced-concrete foundation platform 1,100 ft. long, supported on piles, was built alongside the launching slip to provide for the construction and assembling of two vessels. The program contemplated side launching.

Sliding forms were erected on raised wooden platforms for the seven parallel sections for each ship, and suspended from overhead wooden trusses so that they could be lifted entirely free of the concrete work as each section was finished.

The reinforcing steel was then placed, the longitudinal bars (at that stage of the work vertical) being held by wooden templates at top and bottom, and the transverse steel being wired to them. All steel in a section was placed before concreting started.

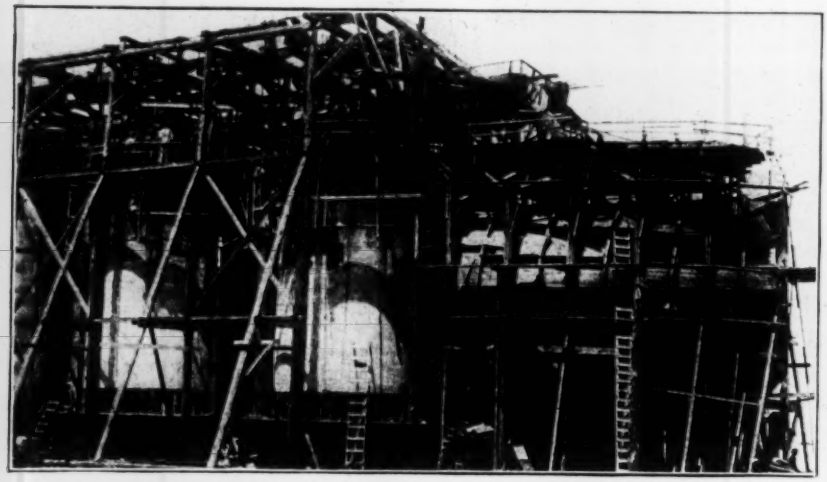
The steel of the transverse bulkhead was laid horizontally on the wooden supporting platform, the bulkhead becoming the bottom of the section in its upright position.

The concrete was then poured, the sliding form being kept going night and day until the section under way was completed.

The sliding form was then raised clear of the concrete work, and the section was then ready, after allowance for proper setting of the concrete, to be turned to the horizontal position and moved into its final place in the ship.

Next the concrete section, still vertical, was lowered by jacks onto steel carriers or "creepers" operating on railroad rails set in the concrete foundation platform. The creepers consisted of rollers running between the rails and I-beam supports carrying the section, the rollers being carried upward around the rear end of the I-beams and restored to place at their forward ends as the movement progressed. The tractive force was provided by a steam-operated winch and cable.

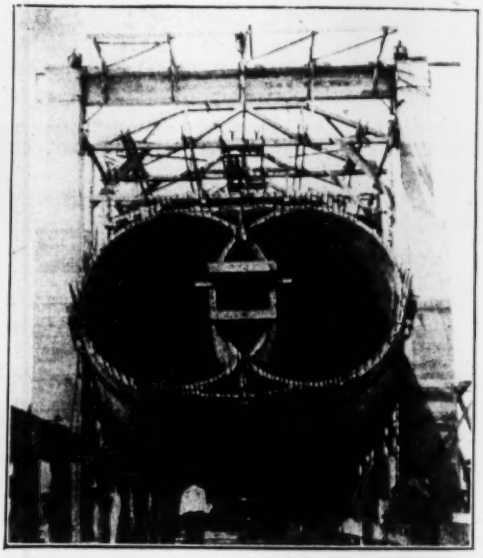
The section was moved forward into a tilting cradle, a structural steel frame carried by shafts running through concrete supporting columns. It was next turned to a horizontal position by winch and heavy tackle and placed on wooden cradles carried on the creepers mentioned above. The creepers then transported it to its final place in the ship.



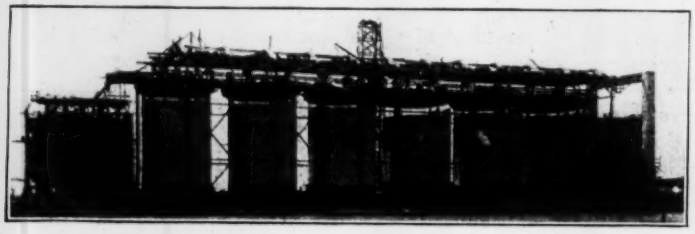
CASTING THE TYPICAL SECTIONS AND THE STERN

TURNING A SECTION FROM THE VERTICAL TO HORIZONTAL

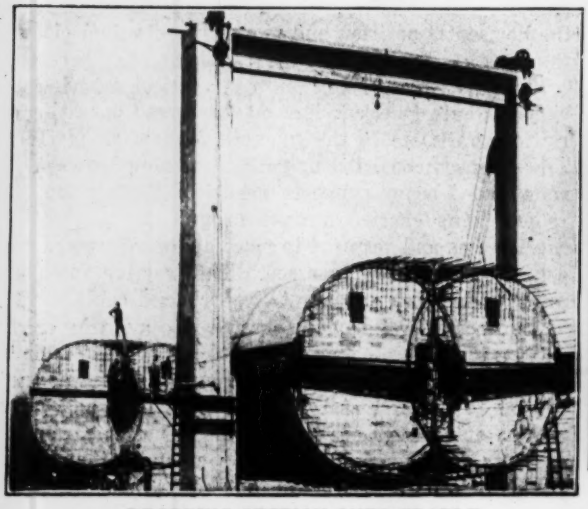
ALL BUT ONE OF THE SECTIONS PRACTICALLY COMPLETED



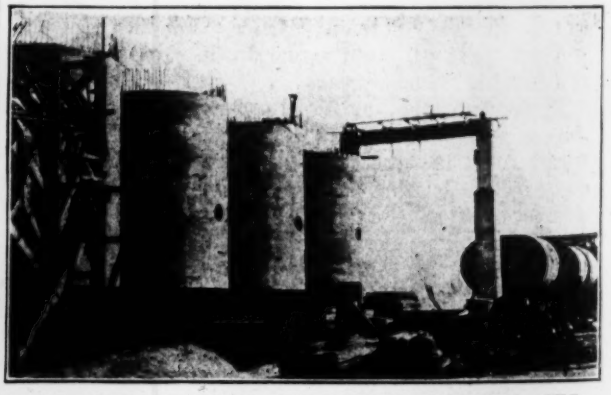
SECTION ALMOST IN HORIZONTAL POSITION



SIDE VIEW OF THE COMPLETED TYPICAL SECTIONS

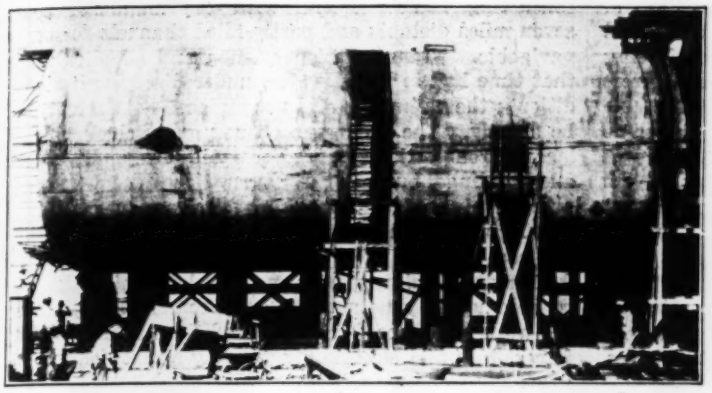


DROPPING SECTION ONTO CRADLE

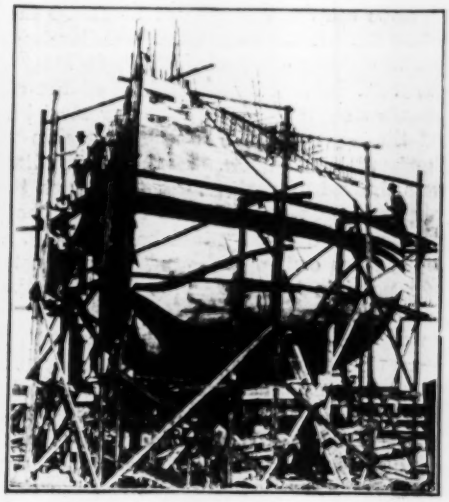


FROM LEFT TO RIGHT—FORM-WORK, VERTICAL SECTIONS, TURNING FRAME, HORIZONTAL SECTION

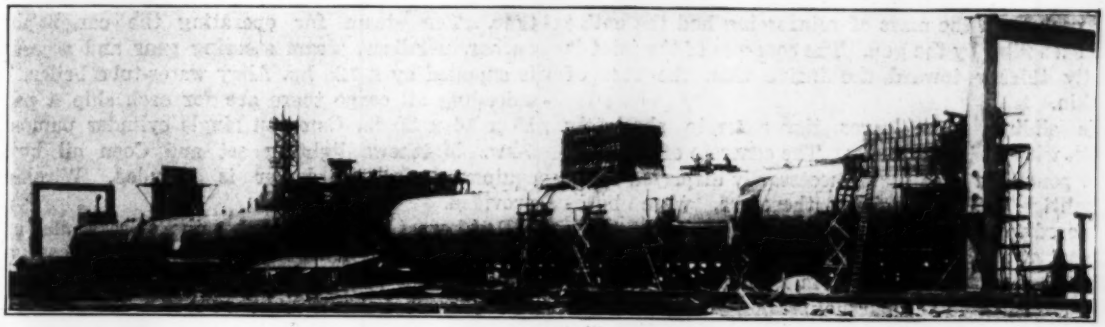
Building 2000-Ton Concrete Tanker



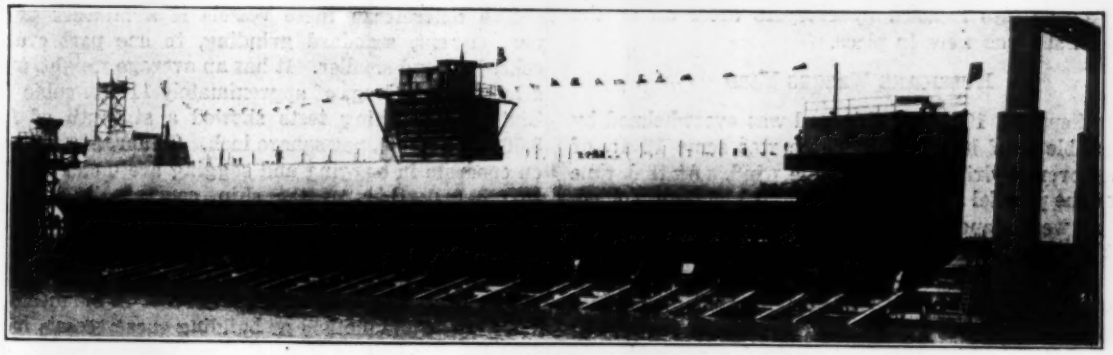
CLOSING TWO OF THE JOINTS



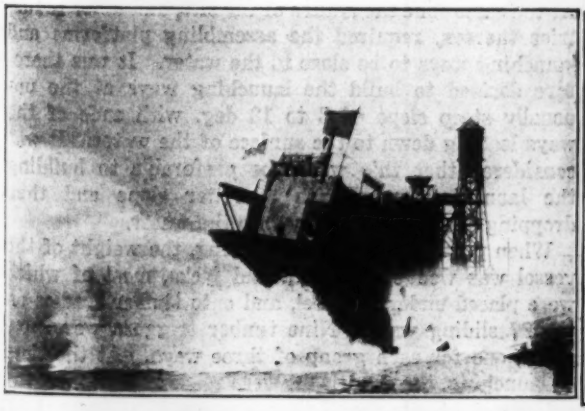
CASTING THE BOW OF THE BOAT



FINAL WORK ON JOINING THE HULL



COMPLETED BOAT READY FOR LAUNCHING



LAUNCHING

LAUNCHED

Each section was molded 26 ft. 10 in. long, instead of 30 ft., but the longitudinal reinforcing steel (vertical while molding) was the full 30 ft. length, projecting 3 ft. 2 in. beyond the upper end of the concrete. This reinforcing meshed with similar steel bars at the end of the adjacent section when the ship was assembled horizontally. The lap of the longitudinal reinforcing was figured of such length that, with the bond stress assumed between steel and concrete, the full allowable tension on the rod would be developed. At the same time, since owing to the method of construction it was not possible to stagger the joints at the ends of the main longitudinal reinforcing, it was thought well not to depend upon bond entirely; and each main bar was therefore clipped to the adjacent bar projecting from the next section by three S clips.

The 3 ft. 2 in. open joints were then concreted by shooting each edge of the joint with cement guns and simultaneously pouring the space between the edges. This secured a bonding between the old and the new concrete not otherwise possible, and at the same time obviated any trouble which might have occurred from sand pockets in the mass of reinforcing had the entire joint been filled by the gun. The concrete of the joint is slightly thicker toward the inside than the rest of the skin.

The sliding form leaves the concrete absolutely smooth without board marks. The concrete of the joint where poured in fixed forms necessarily displayed slight inequalities. These joints, therefore, were bush-hammered to roughen them and were then shot with a thin coat of gunite to give a smooth surface.

The stern section was built in its launching position in fixed forms and the parallel sections were then successively placed in line with it. The bow section was also built in fixed forms, but was supported on cradles and moved into location by creepers after all of the parallel sections were in place.

Hurricane Wrecks Yard

On Sept. 14, 1919, the shipyard was overwhelmed by a terrible Gulf hurricane. There was some 12 ft. of water over it, driven by a 98 mile wind. At that time all of the parallel sections of two ships had been molded, and all were standing on end on their platforms except that three sections of No. 1 hull had been turned to the horizontal and wholly or partially placed. The sternmost cargo section had been put in position and its reinforcing had been clipped to the steel bars of the stern section, which was just ready for concreting to start the next day. The form work for the stern was badly damaged and the reinforcing somewhat displaced but the cargo section next to it (called No. 7) was neither moved nor damaged. No. 6 section, which was in place on shores but had not been clipped to No. 7, was lifted bodily and dropped beyond the inshore edge of the concrete foundation slab. It was undamaged and was readily jacked back into place. No. 5 section was on the creepers and almost in place at the end of No. 6. The cradles were skewed, but the section escaped harm. The bow of No. 1 hull had been concreted; the shores below it were crippled and it dropped about 5 ft. Some skin cracks occurred, which were readily repaired with the cement gun. No other concrete work of the ships was damaged, but the partially completed stern forms of No. 2 hull were entirely carried away; and the sliding forms, with their supporting trusses, over each building way, were wrecked and had to be taken down—thus temporarily upsetting the entire program of duplication on which the plant was based.

The hurricane also carried away the entire railway conencting Harbor Island with the mainland, some seven miles distant; and partly filled channels formerly navigable. Transportation of men and supplies from that time had to be by water, under discouraging conditions; the railway is still not replaced—though it will be shortly. The hurricane opened great channels and lakes through the shipyard, carried away all lumber and buildings, buried or overturned equipment and left over all a mass of heavy crude oil from some 125,000 bbl. lost out of destroyed storage tanks in the neighborhood. In spite of the unpleasant outlook the France & Canada Oil Transport Co. decided to finish the two tankers under construction, and from last September the work has proceeded under conditions at first almost impossible, and necessarily causing great delay, but gradually improving.

The vessels will be driven by twin screws, the power being supplied by Bolinder engines of water injection type. The steam for operating the cargo pumps, anchor, windlass, steam steering gear and accessories is supplied by a 125 hp. Almy water-tube boiler. For unloading oil cargo there are for each ship a pair of 18 x 14 x 20 in. Cameron single cylinder pumps. A 5-kw. Matthews lighting set and Coen oil burning equipment for the boiler is included. Wireless is provided.

Deckhouses are of concrete; the officers' and crews' quarters are in a house amidships where the navigating direction and wheelhouse are located. Provision for a total personnel of twenty-five men is made.

Light-Weight Concrete Used

The concrete in these vessels is a mixture of one part cement, standard grinding, to one part crushed coke, ½ in. and smaller. It has an average weight, exclusive of reinforcing, of approximately 110 lb. cubic foot. Sixty-day crushing tests showed a strength of from 3,500 to 4,000 lb. per square inch. Compression stresses on concrete in bogging and sagging are under 1,000 lb. in other portions of the ship, concrete is, in a few cases, stressed as high as 1,500 lb. under momentarily excessive hydrostatic pressure.

All reinforcing is of high carbon steel, the limiting stress being placed at 16,000 lb. except in bulkheads.

Owing to the method of building these vessels it was found convenient to leave the sections at the elevation they assumed when turned to their horizontal position. At the same time the nature of the site, and other industries thereon, required the assembling platforms and launching ways to be close to the water. It was therefore decided to build the launching ways at the unusually steep slope of 3 to 12 deg. with ends of the ways leading down to the surface of the water. It was considered that this would be preferable to building the launching ways with a flatter slope and then dropping the ship vertically into the water.

When preparing for the launching, the weight of the vessel was wedged onto 10 sand jacks, most of which were placed under her keel, and onto timber cradles on the 27 sliding ways. Nine timber triggers were provided, one for each group of three ways. At the time of launching, the sand jacks were released, bringing the entire weight onto the 27 sliding ways. With the release

of the triggers, the movement of the ship into the water, owing to the steep slope of the ways, occupied but a flash of time.

The launching was carried out with entire success and the vessel was found to draw almost exactly the calculated amount of water. When launched her draft amidships was 9 ft. 6 in. which will be increased to 10 ft. 9 in. with all machinery, water, bunker oil and stores on board. The full load draft will be 18 ft.

Space for water is provided in forward and after peak tanks and in a cross section of the double cylindrical hull, 8 ft. 6 in. long, immediately forward of the stern or machinery portion. Ahead of the double feed water tank just mentioned, a section of the double cylindrical hull 6 ft. long is bulkheaded off for bunker oil tanks.

Unfortunately, the hurricane of September, 1919, carried away the detailed cost records of the work up to that time. Even had they not been, it would be exceedingly difficult to arrive at dependable conclusions as to what the vessels would have cost had the later construction been carried on under nurmal conditions, instead of those following the hurricane. The indications are that reinforced-concrete tankers of this type and constructed in the manner shown can be built for very considerably less than steel tankers. Their action in service will, therefore, be watchd with unusual interest.

The first vessel was christened the "R. P. Durham," in honor of the vice-president of the Macdonald Engineering Co., who originated the general features of the design. The method of construction was worked out by James Macdonald, president of the company, and Mr. Durham. Both the type of ship and manner of construction are covered by patents. The consulting naval architect for the France & Canada Oil Transport Co., for decision of matters of marine concern, was Theodore D. Wells of New York City. At the shipyards, George R. Brooks was consulting engineer for the owners during the greater portion of the period of construction, their interests latterly being in the hands of George P. Darlington. Special credit is due L. H. Stanley, superintendent of construction for the Macdonald Engineering Co., throughout the work, for his loyalty to the operations and efficient handling of it under the unheard of conditions subsequent to the hurricane.

Strength of Aged Cement

Because of cement shortage in the District of Columbia the Corps of Engineers has proposed to use some cement which had been in storage about eighteen months. In order to determine the proper strength assumptions for concrete made of such cement the Bureau of Standards made a number of tests on it. The cement as received was first put through a sieving process to remove the lumps. The cement after sieving, as well as the crushed lumps, were then made into separate concretes which were compared with concrete made from cement recently purchased in the local market. It was found that a 1:1¼:2½ mix of the old cement would give approximately the same strength as a 1:2:4 mix of fresh cement, and it was recommended that the lumps be sieved out of the old cement before using. Similar tests were conducted on aged cements submitted by the U. S. Engineer Office at Vicksburg, Miss. The results indicated that a 1:2¼:4½ mix of the aged cements gave approximately the same strength as a 1:3:6 mix of fresh cement.

Repeated-Stress Safety Factors Quickly Determined

Table of Factors Based on Unit Stress and on Repetitions—Goodman's Diagram and Recent Test Data Used

By J. B. Kommers
Materials Testing Laboratory, University of Illinois, Urbana

In *Engineering News-Record* for Nov. 27-Dec. 4, 1919, the writer discussed the subject "A Broader Use of Johnson's Formula for Repeated Stresses," making use of Johnson's, or Goodman's, diagram, and also of the exponential formula which connects unit stress and cycles which cause failure in repeated-stress tests. Based on the assumption that a decrease of 9 per cent in unit stress doubles the cycles for rupture, it was shown that a very simple relation exists between the factor of safety f based on unit stress and the factor of safety f_1 based on number of cycles for rupture, as follows:

$$0.136 \log f_1 = \log. f \qquad (1)$$

In using this formula it is assumed that the unit stresses obtained from Goodman's diagram would cause failure after 5,000,000 cycles of stress, and the factor of safety f is used in connection with stresses obtained from Goodman's diagram.

There is a certain type of problem, not mentioned in the previous article, which should be explained in connection with the above formula. Suppose a material has an ultimate strength of 150,000 lb. per sq. in., and an elastic limit of 100,000 lb. per sq.in.; what number of cycles of stress would this material be likely to withstand before rupture for various values of minimum and maximum stress? Specifically, four sets of stresses may be investigated:

$$\begin{aligned} -25{,}000 &\text{ to } +25{,}000 \\ 0 &\text{ to } +50{,}000 \\ +25{,}000 &\text{ to } +75{,}000 \\ +50{,}000 &\text{ to } +100{,}000 \end{aligned}$$

It will be noticed that these values are all within the elastic limit, as they should be, and that they also all have the same total range of stress, namely, 50,000 lb. per sq.in. This choice has been made to bring out the fact that according to Goodman's diagram the range of stress alone does not determine the number of cycles that can be withstood before rupture.

Applying to these four cases J. B. Johnson's fundamental formula,

$$S'_1 = \frac{\frac{1}{2} S_u}{1 - \frac{1}{2}\frac{S'_2}{S'_1}} \qquad (2)$$

in which

S'_1 = maximum unit stress as taken from Goodman's diagram,

S'_2 = minimum unit stress as taken from Goodman's diagram,

$S\hat{u}$ = static ultimate strength of the material, the following results are obtained:

Case 1, $\frac{S'}{S'_1} = -1$ and $\frac{1}{2} S_u = 75{,}000$, therefore $S'_1 =$ 50,000 lb. per sq.in. This means that the material could withstand ± 50,000 lb. per sq.in. for about 5,000,000 times before failure. But the stress to be applied is only ± 25,000 lb. per sq.in., therefore $f = 2$.

From formula (1), $f_1 = 164$, and therefore $N = 5{,}000{,}000 \times 164 = 820{,}000{,}000$.

Case 2, $\frac{S'_2}{S'_1} = O$ and $\frac{1}{2} S_u = 75{,}000$, therefore $S'_1 = 75{,}000$ lb. per in. But the material is to withstand only 50,000 lb. per sq.in. so that $f = 1.5$. From formula (1), $f_1 = 19.7$, and therefore $N = 98{,}500{,}000$. In a similar manner the third case gives $N = 9{,}100{,}000$, and the fourth case gives $N = 5{,}000{,}000$.

TABLE I—VALUES OF f AND CORRESPONDING VALUES OF f_1

f	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90
f_1	1.00	2.02	3.82	6.87	11.9	19.7	31.8	49.5	75.3	112
f	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90
f_1	164	234	331	457	624	851	1120	1480	1950	2510
f	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
f_1	3,240	4,070	5,190	6,610	7,940	10,200	12,000	15,100	18,600	21,900

For use in problems of this kind table I, appended, gives values of f and the corresponding values of f_1, thus making it unnecessary to calculate f_1 from the formula.

Highway Department Organization and Administration

Centralized Control of Personnel, Finance and Operations Are Essential Principles, Says Pennsylvania Executive

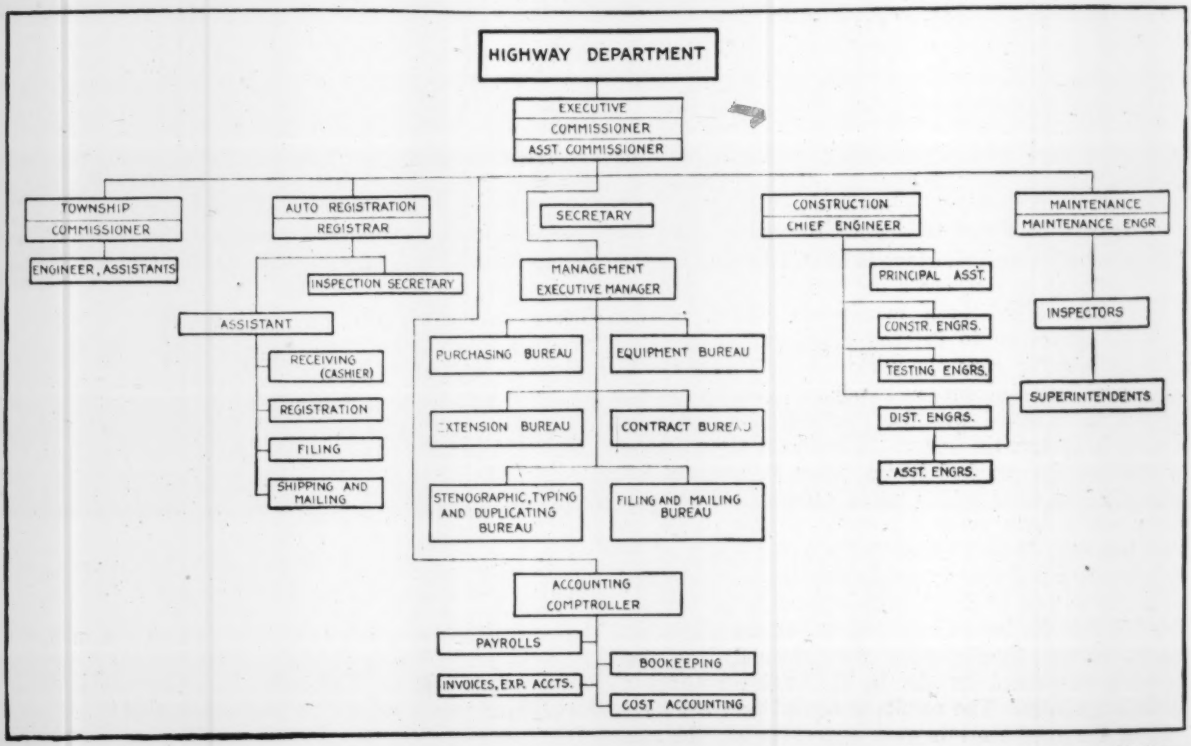
GEORGE H. BILES, assistant state highway commissioner of Pennsylvania, believes that, in view of the immense responsibility placed upon highway commissions in the expenditure of millions of dollars of the people's money, they should "plan for the greatest good to the greatest number, eradicate divisional or sectional lines of work on a broad, comprehensive scale." The following paragraphs embody Mr. Biles's views on the proper constitution of a highway commission:

One of the basic principles in the creation of an organization is to obtain zealous and efficient men who are responsive at all times to the demands of the situation and who will work as a team for the realization of the aims and purposes of the executive. Some encouragement in the form of recognition for meritorious service must be given such men. This is possible only when salaries are not fixed by statute, for when an employee is engaged he should be given a fair compensation and an incentive to put forth his best efforts to merit advancement. There should be but few statutory positions carrying fixed salaries, save the executive officials. Men, under much stress, either go up or out, they cannot stop or grow stale.

Where Authority Should Rest

In developing an organization, combining technical and business functions for work on large scale, such as a state highway department, it is our theory that statutes should be passed empowering the state organization to supervise expenditures and operations, and extend engineering and advisory assistance to the counties, townships or towns. The highly trained engineering force and the organization of the state should be at the disposal of the county to avoid abortions, which are bound to result where innumerable engineers, with as many different ideas, are permitted to operate promiscuously. If there is one thing that will jeopardize the consummation of a road program, it is poor work, which may result from bad engineering or careless inspection. Work should be done under standard specifications and competent inspection. The inspector of a contract is the most important individual on the work, for upon him depends the success or failure of carrying out the engineer's plan. The inspection force should be composed of fair-minded, intelligent and practical men, who hold allegiance to no one save their superiors. These men should be paid a wage commensurate with the importance of the work. It has been our experience that where communities appropriate large sums of money or issue bonds, they welcome the co-operation of the state, as it creates a sense of security on their part, and in good roads campaigns throughout the state this protection has been the biggest contributing factor to their success.

It is through such co-operation that the comprehensive idea of state systems of main primary roads can be extended to the counties on secondary systems or roads of local importance, which tie into the main system, with the ultimate



atisfaction of seeing roads built, not for any selfish interest, but to meet the demands of traffic, starting somewhere and ending nowhere, and creating a network of uniformly good highways. Build roads that with reasonable maintenance will be there at the maturity of your bonds, build for the future, capitalizing high maintenance cost and putting this into the roads.

ORGANIZATION AND SYSTEM

In the administration of highway work on the scale that most of our states are launching at this time, the great single requirement is organization and system. We all have been zealous to the extreme in advocating large appropriations for highway work and money has been thrust upon us with a free hand and now we are bid to perform. Let us first appreciate the wisdom of that truism, "Preparedness is half the battle," and study our problem. Think of it in terms of its similarity to the large industrial organizations where modern business principles predominate and we will realize the magnitude of our task. If we stop and think of the working unit involved in the disbursement of $1,000,000 for this class of work and multiply this by forty, or fifty, or more, as some of us must do, it will be apparent at once that it becomes an undertaking for big business organization and management. There is infinitely more to it than the assembling of large numbers of engineering corps and draftsmen for the preparation of surveys and plans, for this, in a measure, is but incidental, as a contractor who had encountered almost insurmountable difficulties once said to us, "Building roads on paper is not putting them on the ground." There should be a blending of business and technical thought as the basis of action.

In the first analysis the duties of the several units of the organization should be grouped on a functional basis, the segregation of the special or distinct functions automatically creating the several separate divisions. Authority should be centralized in the executive head between whom and the several operating divisions there should be a coordinating branch or body, known as the management division in charge of an executive manager.

The accompanying chart is a graphic representation of Mr. Biles's conception of highway organization.

Estimated British Railway Deficit

The British Ministry of Transport announces that there is an apparent deficit of £54,500,000 likely to accrue to the Exchequer from the state control of railways in Great Britain and Ireland during the current fiscal year ending March 31, 1921, says a recent issue of *Commerce Reports*. The Minister of Transport has accordingly requested the Railway Rates Advisory Committee to suggest increases in the tariffs for various railway services which will wipe out the deficiency by the close of the following June. The last increase in rates was ordered in the latter part of December, 1919.

The Ministry announces that the following is a statement of the per annum increase for the principal items of increased expenditure since last October, when the question of rates revision was referred to the Railway Rates Advisory Committee:

Increased cost of materials	£12,000,000
Increased cost of coal	3,500,000
Increases to shopmen, 11s	4,000,000
Increases to conciliation grades, 5s	4,500,000
Increases to enginemen, 3s Increases to conciliation grades, 1s	2,000,000
Findings National Wages Board	7,000,000
Increases under sliding scale consequent upon rise in cost of living and other concessions, April 12 to July 1	6,800,000
Hire of rolling stock	750,000
Rates, taxes, and compensation	3,200,000
Total	£43,750,000

Adoption of Standard Practice in Railway Work

AUTHORITY as to safe and economical construction and maintenance of American railways is represented by the "recommended practice" of the American Railway Engineering Association, and a more general adoption of these recommendations is likely to result under the present transportation act. This statement summarizes the opening part of a paper in the Association's bulletin for July (No. 227) by C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific R.R. The major part of this article is given below:

With the passage of the Esch-Cummins transportation act, the Interstate Commerce Commission is instructed to make such rates as will, in addition to paying operating and maintenance expense and a proper depreciation, return a certain rate of interest on the investment in the railroads as a whole or in certain groups. In order to be fair to all railroads and to the patrons of the railroads, there should be a classification of the different roads and different sections of the same road, based upon density of traffic, weight of locomotives and frequency and speed of passenger trains. There should be a specification covering construction and maintenance of each class of road, so that the money expended by the different roads will be fairly uniform. No records or recommendations that will permit of this action are based on such general study and careful consideration as those of the American Railway Engineering Association, and it is fair to presume that its recommended practice will be adopted.

There is a strong probability that a stop will be put to the present practice whereby over 50 different sections of rail are rolled between the weights of 70 and 140 lb. per yard, when seven sections will answer all the purposes and are all that are recommended by this Association. A set of rail rolls costs about $5,000 and a rolling mill has to carry an investment of $250,000 for rolls to roll 50 sections, when they would have to carry an investment of but $35,000 to be prepared to roll seven sections. The railroads, and through them the public, have to pay the interest on this additional $215,000 invested by each mill in surplus rail rolls. But the public is not going to continue to pay increased railroad rates to meet the whims of individual railroads.

The same thing applies to rail joints. One of the practices that has the least reason for existence and which costs an immense amount of money per year is that of the variation in punching or drilling bolt holes in rails. There is absolutely no reason why all rails of the same sections should not be drilled with the same spacing. With this standardized, all joints for that section of rail would be drilled alike. Frogs and switches should be the same for the same class of railroads, thus doing away with the innumerable patterns that manufacturers have to carry, and permitting the manufacture of frogs and switches for stock instead of having to make them to order, as is the present practice.

There should be uniformity in width of roadbed, width of cuts at subgrade, depth of ballast, amount of shoulder for ballast of different kinds; also in the use of treated track, bridge and switch ties, and the use of tie-plates. Many roads which have recognized the economy of treated ties and tie-plates have not used them on account of immediate expense.

The new conditions are going to call for the practice that is the most economical in the long run, as the public will have to pay the bills in rates and is entitled to have these rates as low as the best and most economical practice will permit. It is to be hoped that the reorganized American Railroad Association will be used by the Interstate Commerce Commission as the medium through which uniformity of practice can best be secured and that it will be given mandatory powers necessary to enable it to secure these results.

French Government To Regulate River Rhone

Proposed $300,000,000 Project Will Develop Water Power, Improve Navigation and Provide Water for Irrigation

By Thorndike Saville
Associate Professor of Hydraulic and Sanitary Engineering, University of North Carolina, Chapel Hill, N. C.

PROBABLY the most important and gigantic engineering work now being planned in France is the development of the Rhone River from Lake Geneva (Lac Leman) at Geneva to the sea. The proposed development is to be in the threefold interest of water power, navigation and irrigation. Studies have now been completed and the results presented to Parliament, which is shortly expected to authorize the undertaking. While a complete description of the project is not feasible at present, an outline of the salient points of the proposed development should be of interest to American engineers.

The Rhone, after it leaves Lake Geneva (Fig. 1), flows for some 16 miles to the Swiss frontier through a soft alluvium, descending 131 ft. Then commences the French portion which may be divided into several sections. The first is through the Jura to Chateau du Park, a length of 18 miles and fall of 236 ft. The second section is from Chateau du Park to the confluence of the Saone and Rhone below Lyons. This section is less torrential than the first, and at times navigable for small flat-bottomed boats. It has a length of 38 miles and fall of 335 ft. These first two sections of the river are comprised in the area known as the Upper Rhone (Haut-Rhone) and are to be developed the first.

The section from Lyons to the sea is known as the Lower Rhone (Bas-Rhone). From the confluence with the Saone to the confluence with the Isere there are 64 miles with fall of 170 ft.; from the Isere to the Ardeche, 55 miles with a fall of 223 ft.; from the Ardeche to the Gardon, 43.5 miles with a fall of 112 ft.; from the Gardon to Arles, 14 miles with a fall of 26 ft.; from Arles to the sea, 30 miles with fall of 24 ft. On a total length of about 530 km. (329.3 miles) from Geneva to the sea there is a total fall of 372 m. (1,220 ft.). The Upper Rhone is practically non-navigable, and is essentially a torrential stream. Below Lyons the river is full of rapids but has been rendered navigable by certain regulatory works mentioned below. The present plan calls for the immediate development of the water powers of the section above Lyons. These will be readily utilized at a minimum of expense, and the revenues and power derived from them will be of aid in constructing the remaining works. Briefly, the plan contemplates: (1) Rendering the river entirely navigable by the construction of canalized passes (*derivations*) around the most objectionable rapids; (2) the development of power at the dams placed at the heads of these passes; (3) the use of some of the water for irrigation, which will be pumped by some of the electric power developed. The location of the passes, dams, and power plants are shown in Fig. 1.

This somewhat idealistic scheme for the three-fold utilization of the Rhone is of recent origin and represents an entirely new point of view. As late as 1911 the feeling was very strong that the development of the river for navigation was the concern of the state, while that for hydraulic power was essentially for private interests. The development for agriculture was always subsidiary to the preceding. Since the war, however, with the destruction of the coal mines in the north of France and the immediate need of intensive agricultural development, opinion has entirely changed and now all interests are at one in unanimous desire for the triple development. It is believed that the total undertaking will cost in the neighborhood of 1,530 millions of francs ($295,290,000), of which 1,320 millions is for development of electrical energy and 210 millions for accessory works (passes, etc.) to render the stream

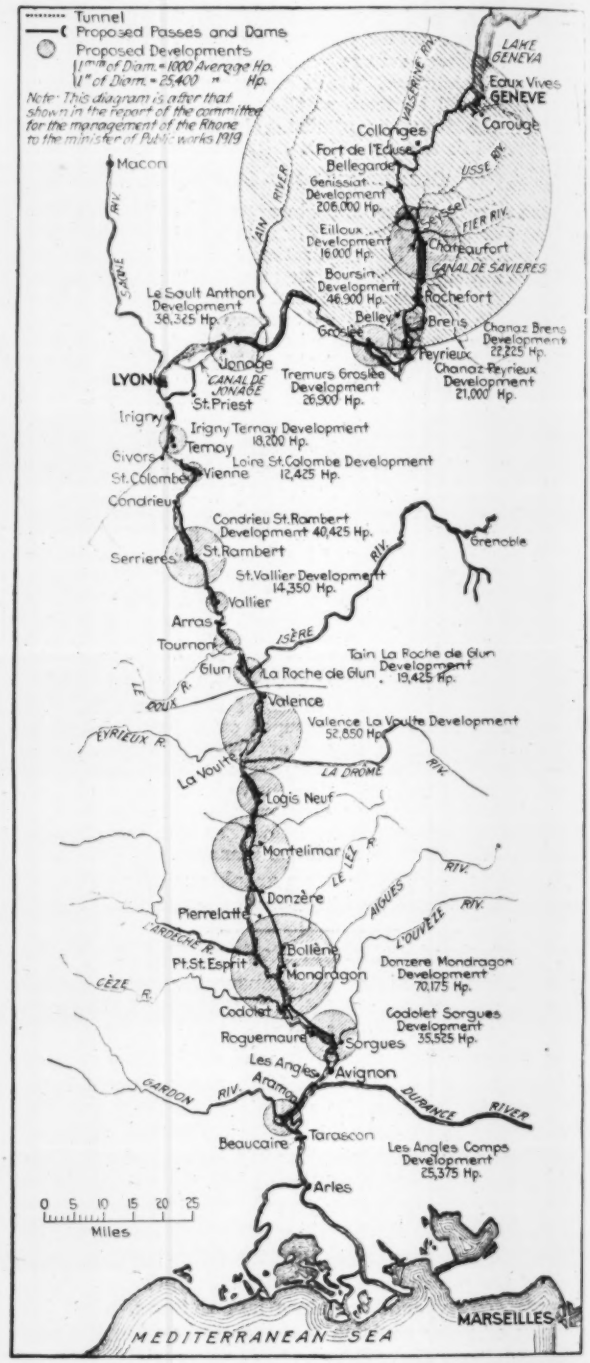


FIG. 1. MAP OF RHONE RIVER SHOWING PROPOSED REGULATORY WORKS

navigable. It was originally conceived that the state should contribute the latter sum only, but in view of the natural benefit arising from the power development and the attendant agricultural advantages, it is now suggested that the state contribute 610 millions of francs or about 40 per cent of the total cost.

The project, which has been favorably reported to Parliament, is due to M. L. Armand, chief engineer in the Ponts et Chaussees, charged with the regulation of the Saone and Rhone.

The plant for the Upper Rhone between Lyons and Geneva, comprises passes of various lengths fed from movable dams operated either by Stoney valves or by wickets as on the Seine. The passes will have a section of 3,445 sq.ft. which will provide for a maximum discharge of 12,350 cu.ft. per sec. The velocity will vary from 1.15 ft. per sec. to 3.61 ft. per sec. (2.46 miles per hr.). The depth of the passes will be 16.4 ft., and the width will be 295 ft. at a point 1 ft. above the water surface, except in certain stretches of difficult excavation where it will be reduced to 164 ft. All curves, with one exception, will have a radius of at least 3,280 ft. (1,000 m.). The locks were originally planned to be 263 ft. in length by 39.5 ft. in width, but these dimensions will doubtless be enlarged, as noted hereafter, to a greater length and 65.6 ft. of width.

The proposed constructions on the Upper Rhone are planned to accommodate barges of 1,000 tons capacity.

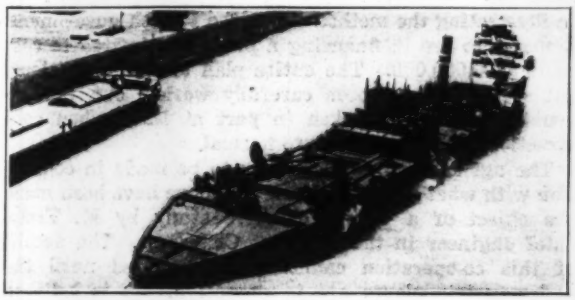


FIG. 2. TOW BOAT ON RHONE PULLING ITSELF UPSTREAM BY CABLE AND WINCH

The standard canal boat in use nearly everywhere in France is of 300 tons (the French or metric ton = 1,000 kilograms, = 1.12 tons of 2,000 lbs.) capacity, 38.5 m. long, 5 m. wide, and draws 1.75 m. (126 x 16.4 ft. by 5.74 ft. draft). On the rivers and larger canals there are 600-ton barges, 210 ft. long, 26 ft. wide and drawing 6 ft. The latter are essentially the dimensions of the barges now in use on the Lower Rhone, dimensions which cannot be exceeded on account of the difficulties of navigation on the river during low water. The greater economy in the use of 1,000-ton barges is obvious, and the canalized river above Lyons can readily be made to accommodate them. It is believed also that by maintaining dredges below Lyons the river may be made navigable for these barges during ten months of the year, until the

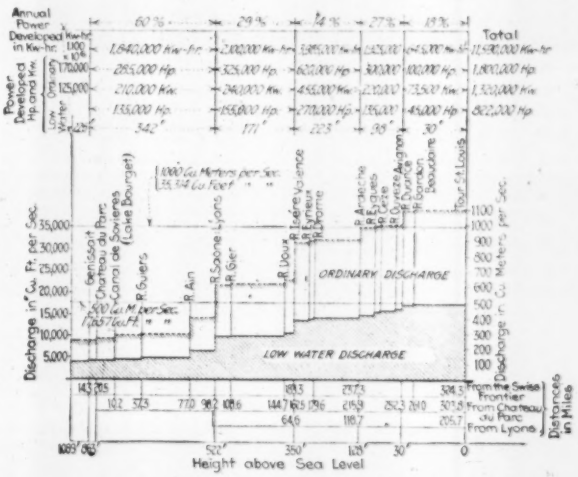


FIG. 5. WORKING PROFILE ON RHONE RIVER

canalization of the lower Rhone is completed. Barges of this size are already in use in portions of the canal from Marseilles to Arles.

These new and large boats will be handled by electric towing apparatus, thus cutting down the expense of the powerful tow boats now used. A typical example, showing the cable by which the boat pulls itself up stream is indicated in Fig. 2, and illustrates the difficulties of navigation as practiced at present.

There is planned also a great terminal port just below Lyons, 2 km. below the confluence of the Rhone and Saone. This port will be connected with the main navigable channel by a lateral canal from the Jonage Canal. The cost of the port, which will be used for storage and transportation, will be 30,000,000 francs ($5,790,000).

The project below Lyons to Arles is essentially the same as for the Upper Rhone. The problem here is somewhat simpler by the fact that the river has already been extensively controlled by regulatory works for the purpose of rendering it navigable. These works consist of dikes parallel to the stream, confining it and causing it to deepen its channel. The dikes are frequently connected with the shore by groins perpendicular to the channel which serve to entrain gravel and build a natural bank. Dikes and groins are constructed of stone. Typical examples are shown in Figs. 3 and 4. These works were begun in 1878 and have been prosecuted ever since with considerable success. The minimum depth in the channel before undertaking the regulatory

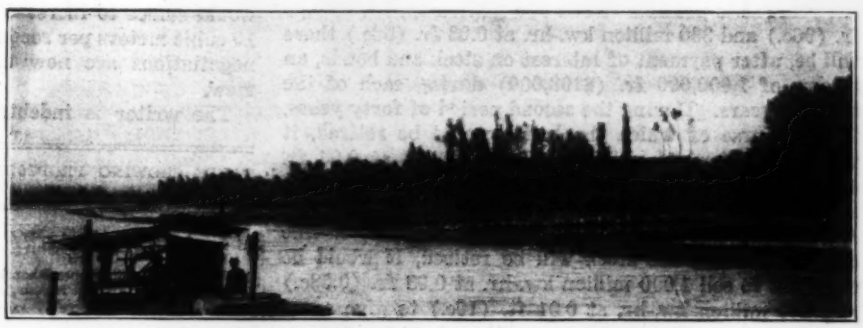


FIG. 3. TRAINING WALLS AND GROINS ON RHONE

works was 0.40 m. (1.31 ft.). Today it is 1.35 m. (4.43 ft.). Before the improvements the annual suspension of traffic on account of low water averaged 70 days per year. At present on not more than five days per year is traffic suspended on this account.

The passes will in all cases be formed by locks at either end and will be fed from the river, which will be dammed at the upper end. At several of these points (shown in Fig. 1) where the fall is considerable, hydro-electric developments will be made. As noted before, those of the Upper Rhone will be developed first as least expensive to construct per unit of power developed. At other points the dams will be larger and have for their principal use the feeding of the passes. The profile of the route showing the falls to be developed is shown in Fig. 5. There is to be developed a total mean annual output of 750,000 hp. The estimated power development on the river is shown in the accompanying table. It is planned to give concessions for this power to last 75 years. The first development on the Upper Rhone would then be financed as follows:

"The capital of 360 millions (francs) is increased above the value at issue by surplus earnings above interest charges and will have a final value of 380 millions at retirement. Of this, 300 millions will be realized by selling bonds at 6 per cent, and 80 millions by stock at 8 per cent. This assumed, in the first ten years of the development it is expected that only 33 per cent of the energy produced can be utilized, and that 75 per cent of the energy will be utilized during a second period of forty years. During this latter period amortization of the bonds will be made, and all (the power) will be utilized at the end of this period. Then during a third period of twenty-five years, amortization of the stock will be made.

"Under these conditions, if during the first period of ten years it is possible to sell 300 million kw-hr. at 0.05 fr. (96c.) and 330 million kw.-hr. at 0.03 fr. (58c.) there will be, after payment of interest on stock and bonds, an income of 1,000,000 fr. ($193,000) during each of the first ten years. During the second period of forty years, in the course of which the bonds would be retired, it will be sufficient to sell 800 million kw.-hr. at 0.04 ft. (78c.) and 550 million kw.-hr. 0.015 fr. (29c.) for the annual net income to be two million francs ($386,000). During the third period of twenty-five years, in the course of which the stock will be retired, it would be sufficient to sell 1,000 million kw.-hr. at 0.03 fr. (0.58c.) and 800 million kw.-hr. at 0.01 ft. (19c.) to give a net annual income of twenty-one million francs ($4,050,000). At the expiration of the concession it should be possible to sell 1,000 million kw.-hr. at 0.02 fr. (0.39c.) and 800 million kw.-hr. at 0.01 fr. (19c.), and there would be an annual income of sixteen millions francs ($3,086,000)."

The development of the Lower Rhone, financed in a similar fashion, is estimated to cost 750 million francs. These figures and the quotations above, are taken from a report by a government committee constituted in August, 1918, to investigate and submit recommendations to Parliament. The engineering scheme adopted is that of M. Armand, and the financial scheme is that of M. de la Brosse, inspector general of Ponts et Chaussees. The data has been given here as of interest in illustrating the method which the French government proposes to use in financing a project estimated to cost some $300,000,000. The entire plan is most ambitious, but seems to have been carefully worked out, and no doubt will be undertaken in part at least when construction activities return to normal.

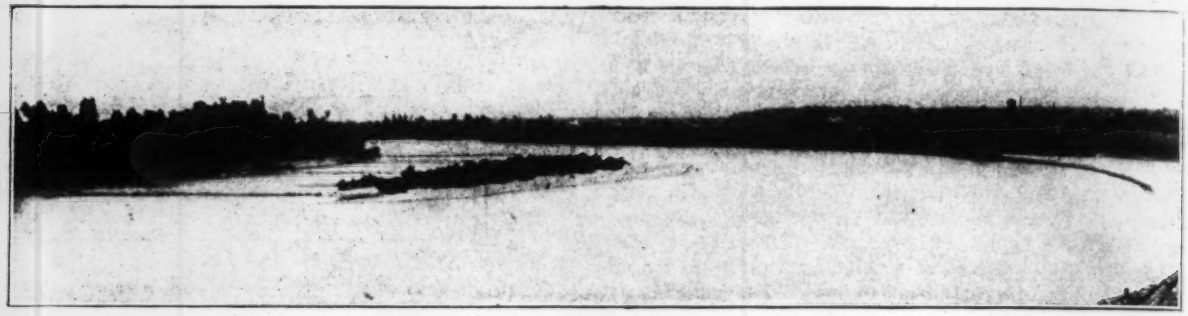


FIG. 4. STONE TRAINING WALLS ON RIGHT. GROINS ON LEFT

The agricultural developments to be made in connection with what has been described above have been made the object of a very exhaustive study by M. Trote, chief engineer in the Ponts et Chaussees. The details of this co-operation cannot be formulated until the hydro-electric plants are in operation. It is believed that these will be able to furnish the moderate amount of power necessary for pumping water to the agricultural districts at a very low rate per kw.-hr. Also, this cheap power will be used in electric haulage on the river passes.

An interesting corrollary of the general regulation of the Rhone is the proposed raising of the level of Lake Geneva. This lake is the great regulatory of the Rhone, and its level is carefully controlled by international agreement so that it does not vary more than 60 cm. (2.36 in.) in a year. The raising of this level by 10 cm. would suffice to increase the discharge of the Rhone by 10 cubic meters per second (353 sec.ft.) for 67 days, and negotiations are now under way with this object in view.

The writer is indebted to the kindness of Georges

TABLE SHOWING PROPOSED POWER DEVELOPMENT ON THE RHONE RIVER—HORSEPOWER

	Mean Low 3 Months	Water-Mean 6 Months	Water-Mean High Water 3 Months
1. Falls of Genissait (Upper-Rhone)	107,000	206,000	260,000
2. Falls, Chateau du Parc to Jonage	134,500	190,500	171,300
3. Falls below Lyon	427,500	387,600	335,100
Totals	669,000	784,100	766,400

Bechmann, consulting engineer, of Paris, and to L. Armand, of the Ponts et Chaussees at Lyons for information and data relating to the above project, and for permission to visit the regulatory works which have already been constructed.

The assumption is made in the table that there is a constant discharge of 1,240 sec.ft. maintained in the passes, and that the variation in power is due to variation in effective head. It is interesting to note that in the torrential unimproved river above Lyon the power developed increases in general with the increase of flow

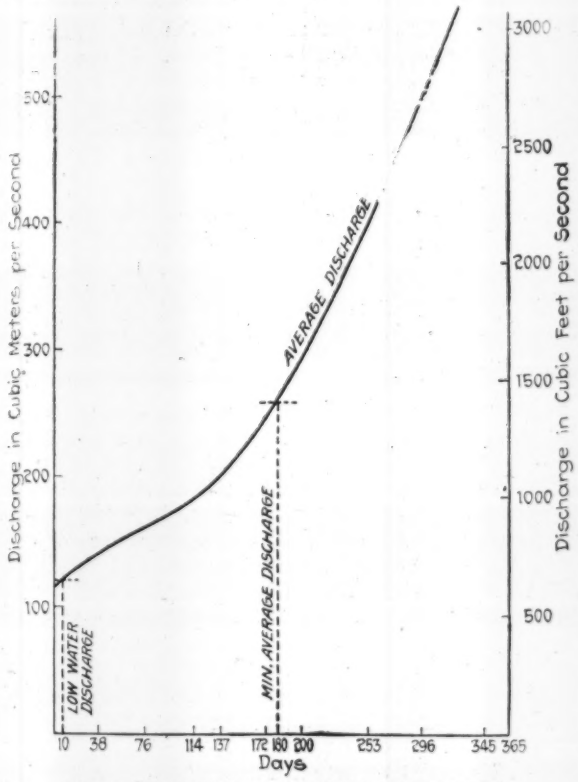


FIG. 6. HYDROGRAPH OF THE RHONE RIVER

in the river. Below Lyon, in the improved portion of the river, in which section the chief tributaries enter, the power developed varies inversely with the discharge of the river.

$40,000,000 for Canadian Roads

Plans providing for the expenditure of $40,000,000 to improve the highways of Ontario and Quebec have been approved by the Canadian government under the operation of the Federal Highways Act. The total outlay contemplated in Ontario is $22,200,000, of which the Dominion government will contribute $5,800,000, the Province $12,000,000, and the municipalities $4,400,000. The principal item is the highway from Windsor to the Quebec boundary. The projected outlay of Quebec is $17,390,000, of which the Dominion will contribute $5,000,000, the Province and municipalities furnishing the balance. In Quebec three standard highways including the King Edward highway from Montreal to Rouses' Point, the Quebec and Montreal North Shore road, and the road from Sevis to Jackman, Maine, are already finished or practically so, and conform in every respect to the standard prescribed by the act.

Tile Drainage a Factor in the Control of Rivers

Will Not the Subsurface Percolation Which Follows Drainage Result in Storage and Better Distribution of Runoff?

BY HYATT L. FROST
McKee, Frost and Smith, Connersville, Ind.

WHAT can we accomplish toward getting materially more of our annual precipitation into the lower subsoil stratum? A practicably constructive solution of this problem means much to most of our humid climate sections. Will systematic tile drainage in these regions of heavy rainfalls put more acre inches of water into the lower subsoil, that is, into the stratum below tile line? An affirmative answer to this question furnishes the major premise for the final conclusion reached in this article.

All the writers on soil physics and allied subject agree that underdrainage is the most, or quite an, effective means of preventing soil erosion, because such drainage—not merely of wet soils, but of all the heavy clays—opens up the subsoil. This is largely brought about by deepened root growth and their resultant decay whereby additional millions of small and many large perpendicular drainage channels are formed in every acre. These channels increase in a progressive ratio as the system grows older. The result of ten or more years of such drainage is a new zone of honeycombed subsoil.

The introduction in comparatively recent years in American agriculture of the deeper rooting plants, particularly some of the tap rooted clovers, is quite materially helping in this direction. That this deeper rooting is many times intensified by tile drainage there can be no doubt. Underdrainage not only quickly and early in the season better dries out the top soil, but rapidly lowers the top line of the upper subsoil water zone. It is a law of plant growth that where moisture is wanting in the top soil, more roots early in life set deeper for their moisture supply. Underdrainage drying out top soils and opening up subsoils inevitably must induce deeper rooting. On my own systems of underdrainage, erosion has materially decreased by reason thereof, and I am sure there is better drouth resistance. Not only have I observed decreased erosion, but decreased outlet flowage from year to year after three to five years' installation of the systems. In short, the older the system becomes the less it works—at its outlet. Observing drainage farmers note the same phenomena.

This has led to further investigations and deductions. I found that old timber-ditched and stone-drained tracts continued to care for the precipitation long after these drains had ceased to work at the outlets, and in some cases as effectually as before. I drained, in 1900, a tract that many springs for thirty years before, had become a bog till near May. This system had a very precarious outlet and I cared for it for five or six years but later owners allowed the outlet to become completely sealed. Still this tract took care of the March, 1913, flood of 9½ in. of rainfall and was ready for gardening in about three weeks, when before March rains of 3 and 4 in. rendered it wholly unfit for from four to six weeks. This tract is now built on and basements are not flooded as was the case near its upper end prior to

the drainage. The only conclusion, after eliminating all possible doubt-creating factors, is that the subsoil was effectually and permanently opened up by a few years of underdrainage.

On theory alone we would logically conclude that if even but for a few hours there shall hang over a lower subsoil a zone of thoroughly saturated upper subsoil, gravitation would put more water below in large part to reach some subterranean reservoir. In short, when we find that a heavy zone of water gravitates through the top soil into the upper subsoil, independent of any augmenting factor such as increased root channels, logically we must conclude that more would get into the lower 3 to 5 ft. zone.

Of course, *first* impression would be that this augmented water supply in the upper subsoil would finally all gravitate transversely into the tile and thence be discharged at the outlet but when we actually find such is not the case, we are forced to the conclusion that the discharge shortage gets below the tile line.

Tile Drainage of Farm Land

Tile drainage is developing wonderfully in Indiana and Ohio on the high, so-called dry, but heavy and even-rolling clays. All agree that the crops on these drained lands stand the drouths better. I have been thoroughly convinced of this by observations on my own systems. It can be accounted for in part by reason of the deepened root-feeding zone, but when we find in a real drouth the soil is almost as dry as powder above the tile line, we then only can account for this successful drouth resistance by reason of an augmented moisture supply below the tile line. These premises alone would seem sufficient to justify the conclusion that there is thus created a zone of increased moisture supply below tile line.

Let us consider the well recognized effect of this decreased run-off on river-control in the way of flood prevention. Even should the soak-in merely be held back in a spongy subsoil, as must be the case for from one to five days, but still shortly finds its way into the streams, it would be about or quite as effective as retarding basins such as are being constructed in the trough of the Miami watershed to protect Dayton, Hamilton, and other cities. Then, too, it is merely an intensification of nature's way of preventing these holocausts. However, if tile drainage not only holds back an acre inch or two of precipitation for several days, but puts another acre inch or more into a subterranean zone, then its flood prevention function becomes indeed real.

Let us go to the other horn of our national dilemma —that of the constancy of our white coal supply and of improved river navigation throughout the year.

An old grist mill man explains that about 1875 his father's power supply began to fail, till for fifteen or more years prior to 1895 they were compelled to shut down each season for from four to six months by reason of water shortage; that his head of water, coincident with the extensive underdrainage installations in the watershed above him, began to return so that since about 1902 he, as successor to his father, has been vouchsafed a dependable water supply throughout the entire season. He long ago came to the conclusion that his augmented water supply was largely attributable to this tile drainage above his dam. "Why," he said to the writer in October, 1919, "you will not find a single tile now working but I am getting the increased water supply just the same and it must be because more water sinks below the tile and gradually feeds subterranean into the creek and its feeders above me throughout the season."

An examination of the stream, a few days later, above and below this dam and of one of its main feeders for several miles disclosed no drainage tile pouring in, but did disclose hundreds of seeps plainly visible at low water stage. The cold spots in the stream bottoms that we are always able to detect with bare feet in warm weather, and the weak springs and seeps that we can always find at low-water stage, are the main sources of dry-weather supply for all our streams. At the time of this examination, I found no water immediately below his crude and shallow, but effective, dam, but as I followed down the old stream bed, there was a slightly augmented supply at each ripple, plainly to be seen as coming from "seeps" only, till at a mile below his dam perhaps 5 cu.ft. in this creek had gathered up. A dam on White Water River each season except those of exceptional summer rainfall has for forty years, to my knowledge, demonstrated this same phenomenon, but in a much more intensified degree. In portions of at least two large feeders of White Water River, under my observation since the early eighties, there has certainly been shown some increased water supply in drouthy seasons and I know this has come from cold spots that formerly did not remain constant, but that now do.

Thus, where there is extensive tile drainage in a given watershed and a decreasing annual flowage at the tile outlets and no flowage at all therefrom in the dry season and an increasingly better dry season stage in the watershed stream, and its feeders. By reason of these conditions one is forced to the conviction that gravitation water below the tile lines is in part correspondingly increased and that from all of this there must result lower flood stage and better dry weather supply. My final conclusion is that systematic underdrainage will, more than any economic human agency, effectively contribute to physical river control by keeping down floods and by keeping up power and navigation stage throughout the season, and that, too, in nature's own way.

As such drainage is being voluntarily practiced in humid sections in an increasing progression, it seems to me that there should be governmental fostering of this most kindly aid to nature, not only from a crop production and a soil conservation, but from a river-control viewpoint.

Approved Federal-Aid Road Projects

According to a bulletin recently issued by the United States Department of Agriculture, up to June 30, 1920, 2,985 projects, involving a total of 29,319 mi. of road, had been approved by the Secretary of Agriculture. The preliminary estimate of the cost of these projects is approximately $385,000,000, of which about $164,000,000 will be approved as Federal aid. On the same date 2,116 projects, representing approximately 15,944 mi., had either been completed or were under construction. The estimated total cost of these projects in various stages of construction, and completed, is $200,000,000. The cost of Federal aid work approved from Dec. 1, 1918, to July 1, 1920—approximately $330,000,000—exceeded by $63,000,000 the cost of all road and bridge work done by the states and counties in the United States during the year 1915.

Open Ditches Excel Tile Drains for Country Roads

Hand-Dug Ditches Constructed and Maintained at Small Cost by Village Communities Near Chicago

By Frank T. Danielson
Northwestern University, Evanston, Ill.

OPEN ditches instead of underground tiles for the removal of water from country roads have proved a great success during the past two years in New Trier Township, Cook County, Ill. This township includes the villages of Wilmette, Kenilworth, Winnetka, Hubbard Woods, and Glencoe. New Trier Township has several miles of both the tile and the open drainage construction and has had an excellent opportunity for comparing the two systems. Its roads pass over a very flat country where prompt discharging of the water from the ditches or tiles is not possible. This causes slight accumulation of water, and extra precautions must be taken in order to protect the subsoil of the roadbed.

Practically the same local conditions exist in regard to grade and outlet along the roads where underdrains are used, as along roads where there are open ditches.

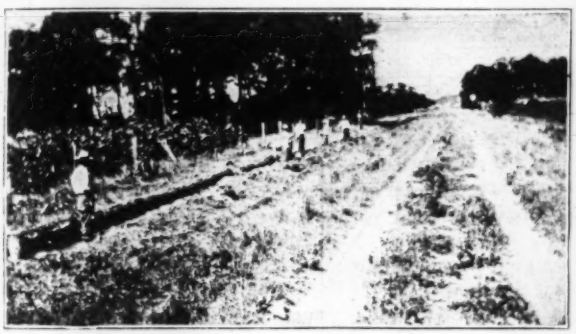


FIG. 1. ARRANGEMENT OF DITCHING GANG

In every instance the open ditch system removes the water in less than one-half the time required by the underdrains and hence eliminates very quickly all danger to which the roadway is susceptible.

New Trier Township has hurried construction of open ditches during the past two years so that nearly all its roads had been ditched by the close of last season. The cost of the work is from 4 to 7c. per lineal foot, based on the average rate of wages for 1919. The work was all done by hand. No teams and slip scrapers could be used on account of the very slight grade available for flow in one direction toward an outlet.

A party of eight men, arranged as in Fig. 1, was found to work most efficiently. One man preceded the other seven, marking the location of the ditch. The next two men removed the first cut with spades. The following four men removed the bulk of the dirt with long-handle shovels and mattocks. They left the ditch at the approximate required elevation. The last man completed the work by cleaning out loose material and finishing the ditch to the grade as fixed by preliminary leveling.

The slope of the side of the ditch nearest the roadbed was made approximately 1 on 2, the far side had a slope of 1 on 1. The cross sectional area varied from

FIG. 2. COMPLETED DITCH WITH EXCAVATED MATERIAL SPREAD ON SHOULDER

2 to 8 sq.ft. Fig. 2 shows a typical ditch after completion. It should be noticed in this connection that the roadbed may be reinforced by the removed soil, thus widening it.

Maintenance of the open ditches for the township has not cost in excess of 1c. per lineal foot per year. The essential thing in maintenance is a yearly cleaning out of weeds and, at places, of a little soil brought in by the water. By such cleaning the surface ditches may always be kept in grade and allow for the rapid discharge of water either in a large or small quantity at any time.

Summing up, the advantages of open ditch road drainage over underdrains are: (1) It provides the quickest means of removing water; (2) it eliminates the high cost of laying and replacing underdrains; (3) obstructions are more easily cleared away; and (4) it widens a roadbed by reinforcing the shoulders.

Credit Institute to Aid Italian Housing

By royal decree dated May 27, the Italian Government authorized the establishment of an institution with headquarters at Rome for the extension of credit to prospective builders of dwelling houses. This institution is designated as L'Instituto Nazionale di Credito Edilizio (National Building Credit Institute), and it will have a fully paid capital of 100,000,000 lire (lira at par of exchange=$0.193). Through its agency financial aid will be granted for the construction of dwellings which are not of a "luxury" character. Preference in the extension of building credit is to be given to undertakings for construction on the part of co-operative organizations or of groups of families.

Shares in the Building Credit Institute may be issued to would-be builders up to 10 times the paid-up capital—that is, for a total of 1,000,000,000 lire. Applicants for building credit, which is to be obtained by suscription to the shares, must put up a sum equal to one-quarter of the amount required for the proposed construction. The interest charged on the institute's loans to builders may not exceed 6 per cent. The security on the loans will be provided by first mortgages on the buildings during construction and after their completion.

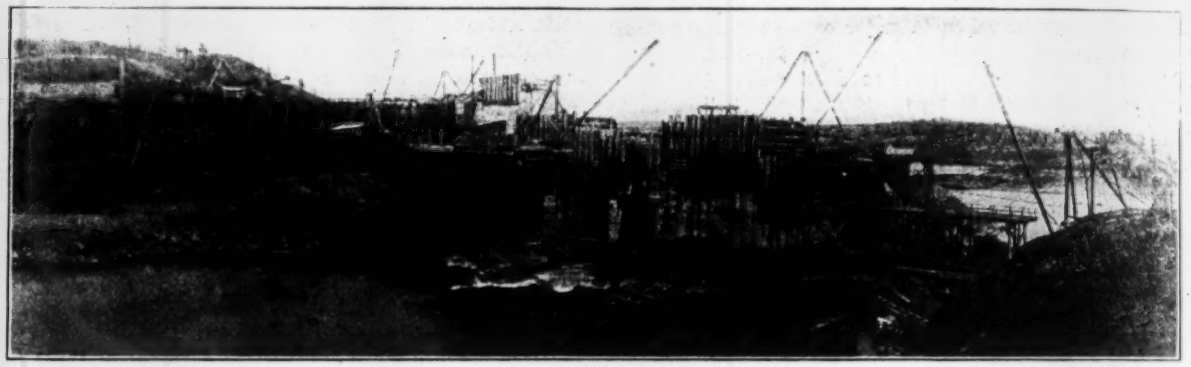
The housebuilder who avails himself of the institute's assistance must file the architect's plans and estimates of the total cost when the credit is granted. In the course of construction, additions or alterations in the plans so filed cannot be made if the expenditure necessary to carry them out exceeds 10 per cent of the original estimated cost of the building. While construction is going on the institute will open a current account with the borrower, which will be converted into an amortizable share on the completion of the building operations, and which will be payable at the end of 20 yr. Payment of interest and installments of the principal will be half yearly.—*Commerce Reports.*

Building Big Eddy Dam on Spanish River, Ont.

Plant Layout and Construction Method Used on Gravity Dam Built Across Valley with Narrow Go[illegible] Requiring Caisson Cut-Off—Work Carried on Through Northern Winter

CONSTRUCTION work on the Big Eddy dam on the Spanish River near High Falls, Ont., was carried on continuously throughout the past severe winter, and the structure, the early work on which was described in *Engineering News-Record*, July 17, 1919, p. 108, is well along toward completion. The layout of the construction plant is somewhat novel, owing to peculiarities of topography at the site, and the closure of the river most intersting.

As described in the earlier article the dam is at present intended merely to form a regulating reservoir to control the operation of a power plant of the International Nickel Co., about ¾-mile downstream. The dam will have a maximum height of 159 ft. and will be 1,100 ft. long, 512 ft. of which is in comparatively low bulkhead. A penstock section is 152 ft. long and the remainder is spillway. Throughout it is of mass concrete section. The river passes through a narrow gorge, which was closed by the use of pneumatic caissons up and downstream, as described in the previous article. Their location is shown on the accompanying layout of the site and plant.



LOOKING AT THE UPSTREAM FACE OF BIG EDDY DAM IN OCTOBER, 1919

Preliminary operations were begun in August, 1918. These were assisted by a standard-gage railroad track, 3½ miles long built at the time of constructing the original High Falls development from the Canadian Pacific R.R. into that site. The old rail was replaced with heavier steel and a number of grades considerably reduced, but in the meantime the line helped materially in starting the work. In order to reach the new dam site at Big Eddy an additional mile of railroad track had to be built. This involved some heavy cuts, fills and trestles, as follows: rock cuts 6,550 cu.yd., earth cuts, 6,100 cu.yd.; total borrow 5,000 cu.yd. and a trestle 945 ft. long with a maximum height of 50 ft.

While the four caissons in the river section (two on the upstream and two on the downstream faces) of the dam were being sunk (December, 1918, to March, 1919), a flume was excavated to take care of the river flow when the work in the natural river bed should be under way. This was dug through a slight natural depression about 100 ft. back from the east side of the river, was 550 ft. long, 25 ft. wide and necessitated the removal of 14,000 cu.yd. of rock. This rock, after being blasted, was loaded by stiff-leg derricks into 6 yd. cars and dumped in piles on the river bank for use later as plums in the concrete. That portion of the flume passing through the dam was lined on sides and bottom with concrete, provision being made for stop logs at the upstream and downstream faces. Later as the dam was built up the flume was roofed over at a height of 42 ft. above the floor.

At the time of starting work on the flume, crib cofferdams were placed at its up and downstream ends and upon completion of the excavation and concrete lining were loaded with dynamite and blown out.

The past winter the concrete was brought in the sluice sections up to El. 212, so as to be above high water in the spring. At this elevation the flume is calculated to carry away 12,000 sec.ft., so a weir had to be formed on the west side of the sluice section capable of discharging another 4,000 sec.ft. At one time the flume and weir combined passing a flood of 12,200 sec.ft. at El. 208 at the upstream face. The flume handled 10,200 sec.ft. and the weir the remainder.

Material Handled from Trestles

During the interval between the completion of the caissons and flume and before the spring break-up, the necessary trestles, derricks, mixer plant, etc., were erected ready to start operations as soon as snow and ice had sufficiently disappeared. This was not until May 5, 1919.

By the middle of June, 1919, the water in the river had subsided sufficiently to allow work to be commenced on the cofferdams which were to complete the closure of the river section previously started by the sinking of the pneumatic caissons. A templet of the size of the proposed cofferdams was constructed, placed in exact location and soundings taken at 2 ft. centers. This method gave very good results for, when unwatering was completed, the bottom of the cofferdams were found to conform very closely with the profile of the ground surface.

Since the cofferdams were securely braced and wedged between the caissons and the rock, considerably smaller coffers than usual were used. The upstream coffer on the west side was built 22 ft. wide and had a maximum

EXCAVATING FOR FOUNDATION BEHIND CAISSONS 1 AND 2.

depth of 38 ft. On the east side, where the greatest depth of water was 28 ft., it was built 15 ft. wide. The downstream coffers had a depth of 38 ft. and were 20 ft. wide. Upon completion and loading of the cribwork, sheetpiling was placed on the water face by divers, an apron of drier felt nailed to the bottom of sheetpiling and laid out in front on the river bottom. Toe fill was then deposited on top of the drier felt.

As will be noted in the sketch showing the general layout, a double-track railroad trestle was built to the mixer plant, which was conveniently situated between the flume and the east bank of the river, and all concrete material taken in cars directly to this plant. The coarse aggregates are dumped into hoppers of 300 cu.yd. capacity, while cement is unloaded above the mixers and fed to them through chutes. Stiff-leg derricks were erected on flat cars traveling on twin trestles in such a way as to be moved easily to any required position along the dam. The concrete trestles were built on the downstream side of the dam and plum derrick trestles above the upstream face.

Gravel and slag from the general hoppers of the mixer plant lead to measuring boxes over the two 1¼ yd. mixers. Cement bags are opened in the cement shed and sufficient cement for one batch placed in bulk in the chutes. An electric bell connected from the mixers to the shed notifies when cement is required. After the concrete is mixed it is dumped into elevator buckets, which are hoisted up to hoppers located just above the concrete trestle. Small flat cars, carrying one-yard buckets, are spotted under these hoppers. When loaded they are moved to the different derricks by means of an engine and cable.

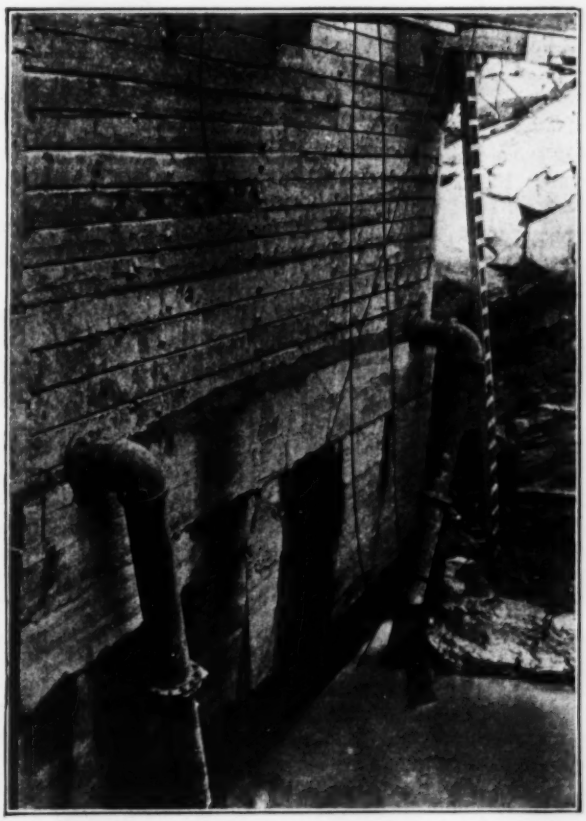
Sand, gravel and slag are used in the concrete. The slag is from the smelter at Copper Cliff and is being used in place of crusher rock. It is delivered in 35-yd. cars as required. Sand and gravel are obtained from a ballast pit alongside of the Algoma Ry., about 13 miles from the dam.

The center of the mass concrete is composed of 1:3:6 mixture, the faces of 1:2-½:5. It was figured that by substituting slag for crushed stone a much heavier concrete would be obtained—the slag concrete weighing about 170 lb. per cu.ft.

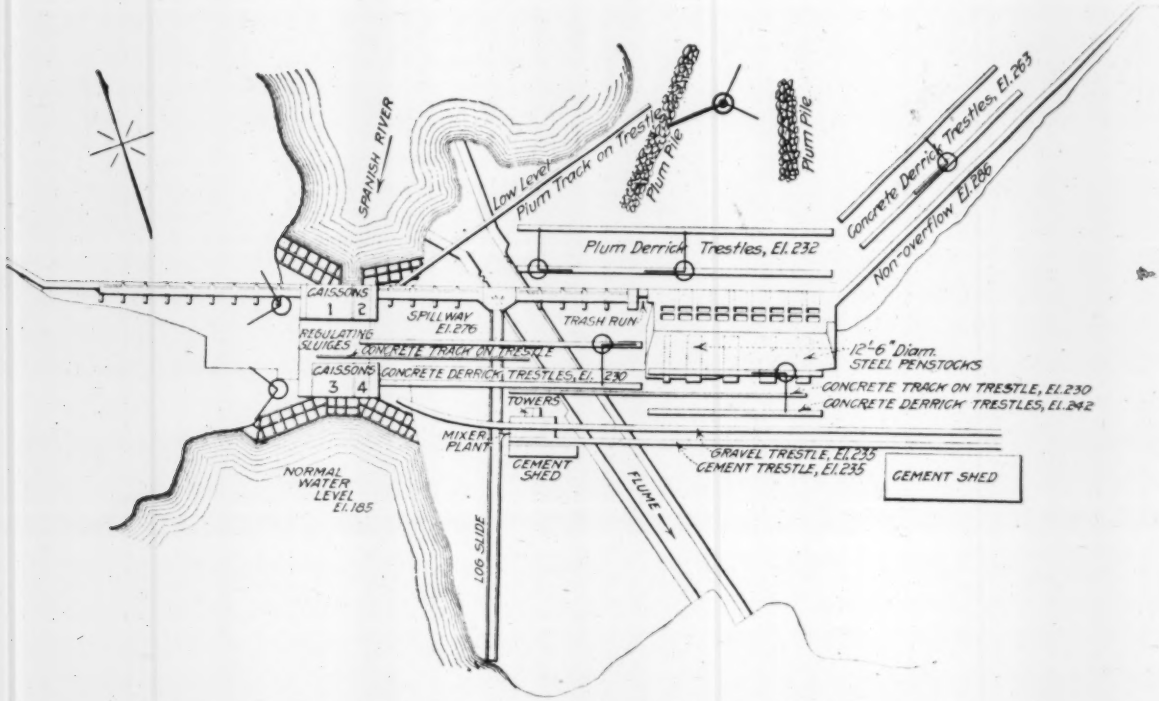
As a precaution against uplift pressure, 2½-in. holes 20 ft. deep were drilled every 10 ft. along and 5 ft. back from the face of the dam. In these, weep pipes were inserted. When the concrete was brought up sufficiently the pipes were connected and carried out to the downstream face of the dam.

The two downstream caissons, Nos. 3 and 4, were built with concrete walls on three sides, but had timber on the upstream wall above El. 161 and 170, respectively. The caissons, after being sunk, were filled solid with concrete to these elevations, the object of this hollow space being to permit a thorough bonding of the downstream caissons with the mass concrete placed between the caisson rows. This avoided what would have been a bad shear plane along the upstream face of caissons Nos. 3 and No. 4. Advantage was taken of these openings for the main pump set-up, as it permitted two 12-in. centrifugal pumps to be placed inside of No. 3 caisson at El. 163, which is 22 ft. below normal water. The suctions of these pumps had previously been built through the wooden wall.

Pumping started Sept. 2, 1919. The general forma-



UPSTREAM FACE OF CAISSON 3 SHOWING PUMP SUCTIONS



LAYOUT OF PLANT FOR CONSTRUCTION OF BIG EDDY DAM ON SPANISH RIVER, ONT.

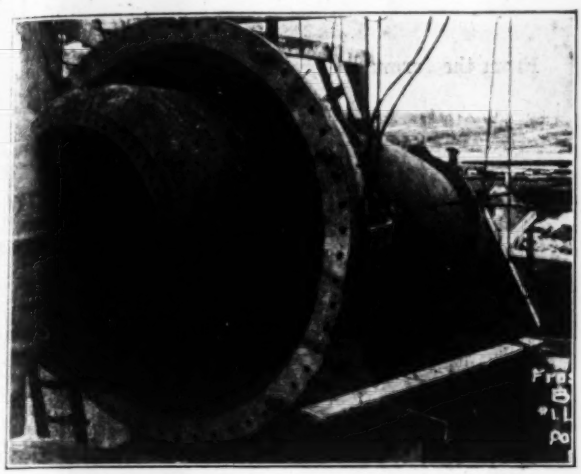
tion of the rock in the river bed sloped from east to west side. A seal was formed on the upstream side between the caisson and the east bank, and as mucking was completed, a series of bulkheads were placed and the concrete poured. No great difficulty was experienced until the west side was reached. There, considerable excavation was required between upstream caisson No. 1 and the bank before a solid foundation was reached, and as the rock rises almost perpendicularly, the working space was small. When this caisson was sunk it was known that the extreme west side of it was not resting on solid rock, and in consequence it would be necessary to get down well below the cutting edge and remove loose rock underneath a portion of the caisson. This is exactly what was experienced. The cutting edge of the caisson was at El. 142.4, and the lowest elevation found under the cutting edge was 127.4. The concrete that filled the working chamber of the caisson was found to be in perfect condition. A good bond was made between this concrete and the fresh concrete and rock. On account of the cramped position here, it was found necessary to put in a small seal about 4 ft. wide at the bottom between the west side rock and the caisson. The water pressures were allowed to equalize and the concrete was tremied. After nine days it was unwatered, and with a 20 ft. head on it, it was found to be perfectly tight.

Some special handling was required in placing the large sluiceway valves. The regulating sluice section is 60 ft. long and is located across the river. When the river is not running over the spillway the flow will be controlled by discharging through three 78-in. Larner-Johnson valves, having a combined capacity of 3,700 cu. ft. with full head. The valves weigh 25 tons apiece, and with the intake and discharge tube connections weigh 52 tons. For erection they were suspended by rods threaded at the upper end so as to permit of easy adjustment in regard to level and grade, while horizontal adjustment was made by jacks.

The ground in the vicinity of the proposed dam, being rough and broken, did not lend itself readily to a camp site. It was necessary to erect the buildings along the hillside, with the result that no building of any size could be constructed without considerable excavation and leveling. Camps for the accommodation of 700 men were erected. The types of buildings varied from long bunk houses, 35 ft. wide by 156 ft. long to small 16 x 24 ft. shacks. The former accommodated 192 men and the latter a varying number depending upon whether used for mechanics, foremen or as married quarters. The difference in size of the buildings was necessitated by the limitations of the site. Three combined cook and mess halls were erected. These had a seating capacity of 200 men apiece. In addition there was also built a two-story storehouse, two-story office, a commissary and a root house.

The dining halls, office, part of the storehouse and most of the camps were heated from a central heating plant. The structure housing these boilers also included a general wash room for the men. In it were both basins and showers.

Near to the job are located the various work shops and power station. The machine shop contains a lathe, shaper, threading machine, drill press and a power hacksaw. At the other end of the building is a blacksmith shop with three forges. The carpenter shop is equipped with bandsaw, ripsaw, rip and butt saw, swingsaw and planer. A compressor house, used for supplying air to pneumatic caissons, rock drills, hoisting engines and small reciprocating pumps, contained one 1,200-ft. capacity low pressure, two 1,050 and one 500-ft. high pressure compressors. Immediately adjoining this is the boiler house of 500 hp., having five boilers of the



ERECTING 78-IN. JOHNSON-LARNER VALVE AT BIG EDDY DAM

bricked-in type. At the commencement of the job the compressors were all driven by steam, but later, electricity, being available, was installed and at present all machinery is driven by electric power received from the nickel company's plant at High Falls. This is delivered to a transformer house on the work at 35,000 volts, where it is stepped down to 550 volts for power and 110 volts for lighting.

The dam is being built for the International Nickel Co. of Canada, Ltd., by Fraser, Brace & Co., Ltd., of Montreal and New York. Henry Holgate, of Montreal, is the consulting engineer for the owner.

Acid Process Tried on Camp Sewage

COMPARATIVE tests of sewage disinfection with niter cake and calcium hypochlorite, made at the United States Naval Training Camp, Gulfport, Miss., show that the niter cake or "acid process is 2½ times as costly as the chlorine process using the equivalent of 10 p.p.m. of chlorine, and that results, bacteriologically speaking, were not so good." The experiments are described at some length in Bulletin No. 31, Public Works of the Navy, for April, 1920.

In his letter transmitting the detailed report mentioned below, Lieutenant Commander L. F. Bellinger, C. E. C., U. S. Navy, states that the tests were undertaken on account of what appeared to be a widely distributed letter from a firm of explosive manufacturers describing the use of niter cake for recovering grease. After the tests were well under way, Lieutenant Bellinger says, there appeared in *Engineering News-Record* of Dec. 5, 1918, an article entitled "Promising Results with Miles-Acid Process of Sewage Treatment in New Haven Tests." This article appears to have suggested to Lieutenant Bellinger the use of the title, "Miles-Acid System of Sewage Purification Compared with Chlorine Process" used by him in his letter of transmittal.

From the detailed report on the tests by Ensign W. B. McElligott it appears that the sewage of the training camp at Gulfport is normally disinfected by calcium hypochlorite after having passed through a grating of steel bars and a septic tank. The niter cake used in the tests, which Lieutenant McElligott says was produced during the war in such unprecedented quantity as to make its disposal a problem to the manufacturer, is described as consisting "of a mixture of approximately 33 per cent free sulphuric acid (H_2SO_4) and 67 per cent of sodium acid sulphate ($NaHSO_4$) and results from the treatment of Chile saltpeter ($NaNO_3$) with sulphuric acid in the manufacture of nitric acid (HNO_3)."

Eight samples were taken for test on five different days, but two samples spoiled. When using niter cake at the rate of 8 p.p.m. the bacterial count of the sewage was 9,000,000 before and 2,000,000 after treatment. In four tests in succession using 29, 22, 47, and 35 p.p.m. of niter cake the bacterial count was in each case 7,500,000 before treatment while after treatment it was 740,000, 1,331,000, 147,000, and 268,000. With 104 p.p.m. of niter cake no report is made for the bacterial count before disinfection, but the count after disinfection is reported as 40,000.

Ensign McElligott concludes from the result of the bacterial counts "that none of the effluent samples were satisfactory from a sanitary standpoint, viz., to contain not more than 10,000 bacteria per c.c. and no colon bacilli." He goes on to say: "Apparently niter cake is useless, in any reasonable amount, for the sterilization of sewage. During the addition of a stronger solution it was noticed that the sewage became markedly flocculated, and that large flocks of fat and fecal matter rose to the surface. This sticky, tarry matter might cause trouble in any practical working of the process by gumming up the screens and rakes. Another grave objection is that the large amount of free sulphuric acid makes the solution very corrosive to the tanks, pipes, fittings, and causes complaint from operators on account of destroyed clothing and shoes. During the addition of the strongest of the above solutions, 1-in. galvanized pipe and fittings were destroyed in 24 hours."

In his letter of transmittal Lieutenant Bellinger compares the cost of niter cake and calcium hypochlorite per 1,000,000 gal. of sewage as follows: Niter cake, 867 lb. at 4⅞c. per lb., $41.18. Calcium hypochlorite, 250 lb. at 6¼c. per lb., less than carload lots, $16.87.

The report states that the sewage of the training camp at Gulfport passes through grease taps before going to the septic tank, so that very little grease gets into the sewer. Presumably for this reason no attempts at grease recovery were made at Gulfport. However, Lieutenant Bellinger says in his letter of transmittal: "Information from the Reclamation Division of Camp Greene, Charlotte, N. C., dated Nov. 25, 1918, states that the amount of grease recovered in the niter cake process is very small, and that this method is used more for sanitary reasons than for the actual collection of grease."

Claim Irrigation Company Is a Utility

The Bitter Root Water Co., successor to the Bitter Root Valley Irrigation Co., claims that it is a utility and that its rates to irrigators are subject to regulation by the Public Service Commission of Montana. The U. S. District Court holds that the contracts between the original company and its water users are not subject to commission control. The commission agrees with the contention of the company, maintaining that irrigation rates are subject to the joint jurisdiction of the Public Service Commission and the Irrigation Commission—which have the same members. Further litigation is expected.

New Transition Curve Based Upon the Lemniscate

By J. E. Williams

TRANSITION curves in railway track are introduced to give a gradual change from the tangent to the main circular curve and from the level rails on tangent to the superelevation of outer rail on the main curve, the purpose being to ease the motion of trains entering and leaving curves. At the point (*P.S.*) where the transition curve leaves the tangent the curvature should be zero. At the point (*P.C.C.*) where the transition curve meets the main curve its curvature should equal that of the latter. The change in curvature between the two points should take place in such manner as to allow the elevation of the outer rail to increase uniformly with the length of the curve, and as to be just sufficietnt at every point to balance the centrifugal force. The aquation of a curve which meets these requirements can be derived as follows:

Let h = elevation of outer rail,
l = gage of track,
v = velocity of train,
R = radius of curvature,
s = length of curve from P.S.,
W = weight of train.

The weight W can be resolved into two components, one perpendicular to the incline of the track and the other parallel to the incline. Since the component parallel to the incline and the centrifugal force are practically equal, we have

$$\frac{Wh}{l} = \frac{W v^2}{g R} \qquad (1)$$

If h increases uniformly with s, h/s is a constant. Then since v, g, and l are constants also, we have

$$Rs = C \text{ (a constant)} \qquad (2)$$

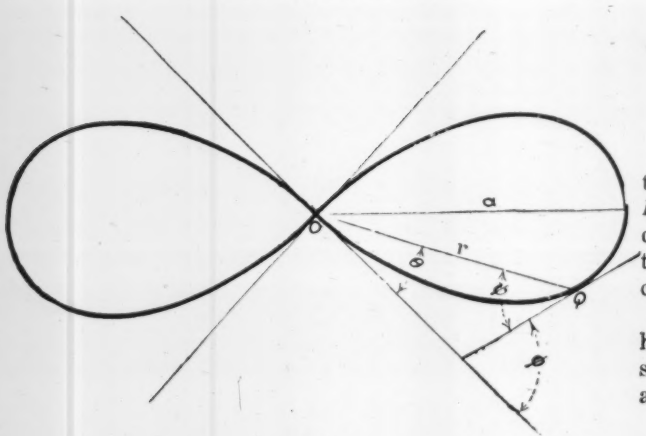


FIG. 1

Equation (2) is one form of the equation of a Cornu's spiral and represents the true transitiion curve. Points on a curve are usually located either from the tangent or by deflection angles. No easy way has been found for locating the points on the true curve by either of these methods. As a result, a number of modifications have been used. The purpose of this article is to present the lemniscate as still another modification.

The equation of the lemniscate, Fig. 1, can be writt

$$r^2 = a^2 \sin 2\theta \qquad (3)$$

From the formula

$$\tan \psi = \frac{r d\theta}{dr}, \text{ we have}$$

$$\tan \psi = \tan 2\theta$$

Therefore

$$\psi = 2\theta \qquad (4)$$

This is an important property, and it holds for eve point on the curve.

By using the formula

$$R = \frac{\left[r^2 + \left(\frac{dr}{d\theta}\right)^2\right]^{\frac{3}{2}}}{r^2 + 2\left(\frac{dr}{d\theta}\right)^2 - r\frac{d^2 r}{d\theta^2}},$$

the radius of curvature is found to be

$$R = \frac{a^2}{3r}, \qquad (5)$$

or

$$Rr = C' \text{ (a constant)} \qquad (6)$$

The values of θ, Fig 1, in a transition curve are never large, and it can be shown by expanding s/r that for small values θ, s does not differ greatly from r. If s is substituted for r, equation (6) becomes identically the same as equation (2).

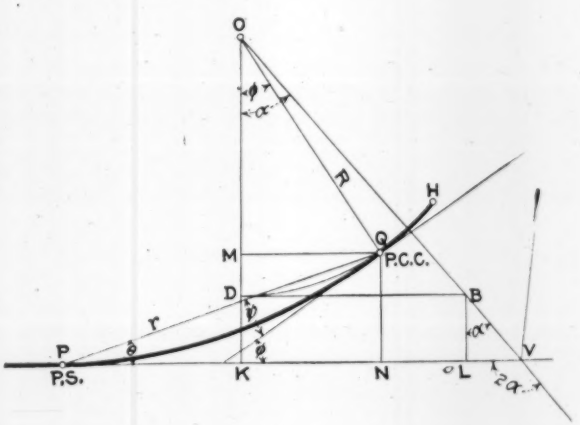


FIG. 2.

Referring to Fig. 2, QH is a part of the curcular track, and PQ is the transition curve. The curvature at P is zero. From this point the curvature gradually increases. At Q the transition curve and the circle have the same curvature, a common tangent and a common center of curvature.

Let s_c, R_c, r_c, and θ_c be the values which s, R, r and θ have at the point Q. Combining (3) and (5), and substituting s for r, we have, for calculating the deflection angles,

$$\sin 2\theta = \frac{s^2}{3R_c r_c} \qquad (7)$$

The next step is to find an expression for the tangent distance. Only the case in which the same curve is used at both ends of the circular part of the track will be considered here. If T is the tangent-distance, then

$$T = PK + KL + LV, \qquad (8)$$

$$PK = PN - QM = r\cos\theta - R\sin = r\cos\theta - R\sin 3\theta$$

$$KL = BD = R \tan \alpha,$$

$$BL = QN - MD = r \sin \theta - (R - R \cos 3\theta),$$

$$LV = BL \tan \alpha,$$

Substituting in (8),

$$T = r \cos \theta - R \sin 3\theta + [r \sin \theta - (R - R \cos 3\theta)] \tan \alpha + R \tan \alpha$$

$$= \frac{r \cos (\theta - \alpha) + R \sin (\alpha - 3\theta)}{\cos \alpha} \qquad (9)$$

From equations (3) and (5), $r = 3R \sin 2\theta$. If this value of r is substituted in (9), we have, after a simple trigonometric reduction,

$$T = \frac{R}{2 \cos \alpha} [3 \sin (\theta + \alpha) - \sin (\alpha - 3\theta)] \qquad (10)$$

The values of R and θ to be used in (10) are the values which they have at Q.

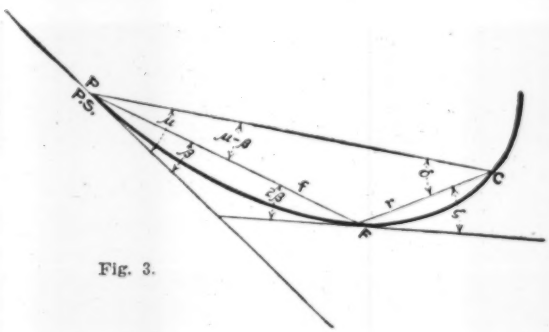


Fig. 3.

In case the curve cannot be completed from *P.S.*, the transit can be moved to some intermediate point F, Fig. 3, and a new tangent established in the usual way. Let β and μ be the deflection angles for F and C, respectively, when measured from *P.S.* Let ξ be the deflection angle for C when measured from F. Let f and r be the lengths of the chords PF and FC, respectively, Then

$$\delta = \xi + 3\beta - \mu$$

also

$$\frac{\sin \delta}{\sin (\mu - \beta)} = f/r$$

Substituting for δ, we have

$$\sin (\xi + 3\beta - \mu) = f/r \sin (\mu - \beta) \qquad (11)$$

The ratio $\frac{f}{r}$ is nearly equal to the ratio of the arcs PF and FC. The values of β and μ are to be calculated from (7). The value of ξ can then be calculated from (11).

When the angle δ and the angle μ—β are both small, quite accurate results can be gotten from the equation

$$\xi + 3\beta - \mu = f/r(\mu - \beta) \qquad (12)$$

Milk Pasteurization Ordinance Legal

The Wisconsin Supreme Court has upheld the legality of an ordinance of the city of Milwaukee requiring all milk sold in that city to be pasteurized except when certified or from tuberculin-tested cows. (Pfeffer et al. vs. City of Milwaukee et al., 177 N.W. 850.)

The True Transition Curve for Railway Problems

New Method as Simple as Methods Commonly Used in Applying Approximate Transitions to Curves and Turnout Work

By George Paaswell
Consulting Engineer, New York City

THE best transition or easement curve for use in railway work is that in which the curvature varies directly as the distance measured along the curve, starting at zero at the *P.T.C.* and attaining the proper amount of the *P.C.* or circular curve (see Crandall's "Transition Curve"). Such a transition insures the easiest riding and agrees directly with the superelevation, but the mathematical difficulty attendant upon its use has made it hard to apply to problems in the office and the field. For this reason, other transitions are used frequently which are approximations to the true transition curve as defined above. Among these are the compound curve, the cubic parabola and the Searle's spiral.

It is the purpose of this article to place the mathematical work of the true transition curve on a clearer basis, deriving functions which, with appropriate tables, will make it easy to apply the curve in practice. These tables may be developed eventually to furnish data as complete as trigonometric tables now furnish for simple curves.

TABLES FOR THE TRUE TRANSITION CURVE

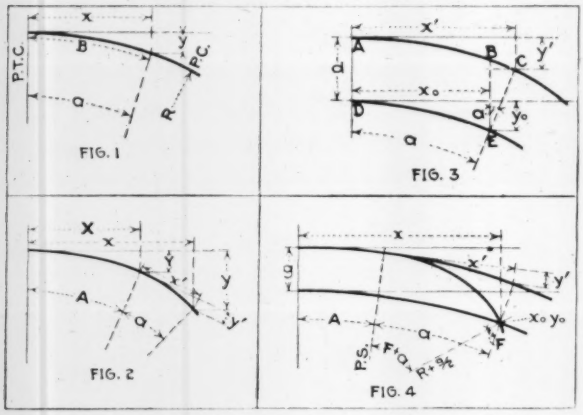
Values for the function $U(\alpha)$

Deg.	0	10′	20′	30′	40′	50′
0	0.0000	0.0010	0.0019	0.0029	0.0039	0.0048
1	0.0058	0.0068	0.0078	0.0087	0.0097	0.0107
2	0.0116	0.0126	0.0136	0.0145	0.0155	0.0165
3	0.0175	0.0184	0.0194	0.0204	0.0213	0.0223
4	0.0233	0.0242	0.0252	0.0262	0.0271	0.0281
5	0.0291	0.0301	0.0310	0.0320	0.0330	0.0339
6	0.0349	0.0358	0.0368	0.0378	0.0388	0.0398
7	0.0407	0.0417	0.0427	0.0436	0.0446	0.0456
8	0.0465	0.0475	0.0485	0.0495	0.0504	0.0514
9	0.0523	0.0533	0.0543	0.0553	0.0562	0.0572
10	0.0581	0.0590	0.0600	0.0610	0.0620	0.0629
11	0.0638	0.0648	0.0657	0.0667	0.0677	0.0686
12	0.0696	0.0706	0.0716	0.0725	0.0735	0.0745
13	0.0754	0.0763	0.0773	0.0782	0.0792	0.0802
14	0.0811	0.0821	0.0831	0.0840	0.0849	0.0859
15	0.0869	0.0878	0.0887	0.0897	0.0906	0.0916

Values of the function $T(\alpha)$

Deg.	0	10′	20′	30′	40′	50′
0	1.0000	1.0000	1.0000	0.9999	0.9999	0.9998
1	0.9997	0.9996	0.9995	0.9993	0.9992	0.9990
2	0.9988	0.9986	0.9983	0.9981	0.9978	0.9975
3	0.9973	0.9969	0.9966	0.9963	0.9959	0.9955
4	0.9951	0.9947	0.9943	0.9938	0.9934	0.9929
5	0.9924	0.9919	0.9913	0.9908	0.9902	0.9896
6	0.9890	0.9884	0.9878	0.9872	0.9865	0.9858
7	0.9851	0.9843	0.9836	0.9829	0.9821	0.9813
8	0.9805	0.9797	0.9789	0.9880	0.9771	0.9762
9	0.9753	0.9744	0.9735	0.9725	0.9715	0.9706
10	0.9695	0.9685	0.9675	0.9664	0.9653	0.9642
11	0.9631	0.9620	0.9609	0.9597	0.9586	0.9574
12	0.9561	0.9549	0.9536	0.9524	0.9511	0.9498
13	0.9485	0.9472	0.9459	0.9445	0.9431	0.9417
14	0.9403	0.9388	0.9374	0.9359	0.9345	0.9330
15	0.9314	0.9299	0.9284	0.9268	0.9252	0.9236

This true transition curve has been analyzed by Euler and a host of other mathematicians. It was defined by a set of Euler integrals and was also termed the Euler spiral; more lately it has been termed the clothoïde. The fundamental properties of the curve may be derived in the usual manner: Take r as radius of curvature at any point s of the curve, measured from the point of tangency, the *P.T.C.*; at the *P.C.* the radius is R, that of the simple curve, and s becomes L, the total length of the transition. From the intrinsic relation (see Fig. 1).



$$da/ds = 2\,k\,s \qquad (1)$$

$2\,k$ is a constant, which is evaluated by noting that when $s = L$ the curvature in (1) is $1/R$. Thus defined

$$k = 1/2\,RL \qquad (2)$$

Integrating (1) $$a = k\,s^2 \qquad (3)$$

From the trigonometry of the infinitesimal triangle

$$dy = ds \sin a \qquad (4)$$

$$dx = ds \cos a \qquad (5)$$

From (1) and (3),

$$dy = \frac{1}{2\sqrt{k}} \frac{\sin a}{\sqrt{a}}\,da \qquad (6)$$

$$dx = \frac{1}{2\sqrt{k}} \frac{\cos a}{\sqrt{a}}\,da \qquad (7)$$

and

$$x = \frac{1}{2\sqrt{k}} \int_0^a \frac{\sin a}{\sqrt{a}}\,da \qquad (8)$$

$$y = \frac{1}{2\sqrt{k}} \int_0^a \frac{\cos a}{\sqrt{a}}\,da \qquad (9)$$

These integrals define new functions and, when a is finite they can be found by expanding the integrand and integrating term by term. Performing this integration

$$x = s\,T(a) \qquad (10)$$

$$y = s\,U(a) \qquad (11)$$

where $T(a)$ and $U(a)$ are the new transition functions which stand for the infinite series

$$T(a) = \sum_0^x \frac{(-1)^n\,a^{2n}}{(4n+1)\,(2n)!} \qquad (12)$$

$$U(a) = \sum_0^x \frac{(-1)^n\,a^{2n+1}}{(4n+3)\,(2n+1)!} \qquad (13)$$

These are formidable looking expressions but are of but little more complexity that the analagous functions defining the sine and cosine, which may be written in the form

$$\sin x = \sum_0^x \frac{(-1)^n\,x^{2n+1}}{(2n+1)!}$$

$$\cos x = \sum_0^x \frac{(-1)^n\,x^{2n}}{(2n)!}$$

For infinite values of a:

$$\int_0^\infty \frac{\sin a}{\sqrt{a}}\,da = \int_0^\infty \frac{\cos a}{\sqrt{a}}\,da = 1\sqrt{\pi/2}$$

so that, as a mathematical curiosity, the co-ordinates of the terminus of the transition are

$$x = y = \frac{1}{2}\sqrt{\pi/k} = \frac{1}{2}\sqrt{2\pi RL}$$

Tables for the values of the T and U functions are given here and it is hoped will eventually be carried out to a full range of the angle values. The deflection of the curve is given by

$$\tan d = y/x = U(a)/T(a)$$

The transition curve has now been rigorously defined. The application to specific problems will emphasize the fact that such a definition is far superior to the use of approximations and corrections in that a clear view is had at all times of the curve properties.

PROBLEM 1—*Tangent Offsets.* To determine the offsets from the tangent at any point X, Y, on the transition, see Fig. 2. By the principles of the transformation of co-ordinates the new co-ordinates x', y', referred to the points X, Y as origin are related to the old co-ordinates referred to the *P.T.C.* as origin:

$$x' = (x - X)\cos A + (y - Y)\sin A \qquad (14)$$

$$y' = (y - Y)\cos A - (x - X)\sin A \qquad (15)$$

Refer these functions back to the functions as defined in (10) and (11), and there is,

$$x' = Js - IS \qquad (16)$$

$$y' = Ms + NS \qquad (17)$$

$$J = T(A + a)\cos A + U(A + a)\sin A;\ I = T(A)\cos A + U(A)\sin A$$

$$M = U(A + a)\cos A - T(A + a)\sin A;\ N = T(A)\sin A - U(A)\cos A$$

The angle a is measured from the point of tangency, the point X,Y. Note in (16) and (17) that for any fixed point IS and NS are constant and to determine the offsets it is necessary to compute J and M for each point. It must be remembered that s is measured from *P.T.C.* each time.

In similar fashion, when it is desired to get the offsets running back on the transition toward the *P.T.C.*

$$x' = IS - s\,P \qquad (18)$$

$$y' = NS - s\,Q \qquad (19)$$

$$P = T(A - a)\cos A + U(A - a)\sin A;\ Q = T(A - a)\sin A - U(A - a)\cos A$$

Those who have had occasion to compute offsets from odd points along the transition will appreciate the comparative simplicity of these expressions, when a table of the new functions is available. The deflections may be computed from the offsets in the same manner as before.

PROBLEM 2—*Curves Parallel to Transition.* See Fig. 3. It is to be noted that the transition curve is the center line of the track. The rails are parallel curves

separated by a distance $\frac{1}{2}\ g$, where g is the gage of track. To make the problem general the distance is noted here as d. The definition of parallel in this sense is that a normal to the transition is also normal to the parallel curve and that the distance intercepted on this normal between the two parallel curves is the distance d. Thus defined the co-ordinates on the curve AC at the point C are related to the corresponding co-ordinates on the transition DE

$$x' = x_o + d \sin a \qquad (20)$$

$$y' = y_o + d(1 - \cos a) \qquad (22)$$

It may also be assumed as a property of parallel curves that the distance AB on the curve is equal to the distance DE on the transition. Calling DE, s and AC, s',

$BC = s' - s$. From (20) and (10)

$$BC = d \sin a / T(a) \qquad (22)$$

PROBLEM 3—*Turnouts.* To locate a turnout from a transition curve involves generally a long office computation. The following should illustrate the simplification of this problem using the new function and the tables based upon them (see Fig. 4). The point of switch is assumed to be given and is located as shown. In all that follows the converse may be taken; the point of frog being assumed and the point of switch to be located. In this work the theoretical switch layout is assumed with point intersections and not the actual stub intersections with tangent throws and frogs. To apply the practical layouts would needlessly complicate the problems and introduce useless refinements. The frog angle is F. The co-ordinates of the frog referred to the circular turnout, x_o y_o are

$$y_o = (R + g/2)\ (1 - \cos\ (F + a)\ )$$

$$x_o = (R + g/2) \sin\ (F + a)$$

$$y_o/x_o = \tan \frac{F + a}{2}$$

These co-ordinates may be referred back to x', y' as defined by (20) and (21) and in turn to co-ordinates referred to the *P.T.C.* as origin as given in (14) and (15). There is then

$$\tan \frac{F + a}{2} = \frac{sM + SN - g(1 - \cos a)}{sJ - SI - g \sin a} \qquad (23)$$

A few trials will suffice to determine the proper value of s to use to give the value of a to satisfy this condition. Having found this, the value of the radius of the turnout may be taken from one of the equations above. Remember that here s is measured all the way from the *P.T.C.* along the outer rail while a is measured from the *P.S.* only.

The problem may, of course be extended to include cases where the *P.S.* is on the tangent, or on the circular curve and the frog point on the transition. There should be no difficulty in deriving the condition equations as above shown for these cases.

An arithmetical problem may render the above literal work a little clearer. Take a length of transition of 300 ft. and a radius of simple curve, 1,500 ft. Let the station of the *P.T.C.* measured along the center line of track be 0 + 00 and let the point of switch be at the point 1 + 00. The central angle a at this point is, from (3), 0.0111 in circular measure or 0°40′. The switch turnout is to be as shown in Fig. 4. The gage of the track is taken as 4.708 ft. The length S for the outer rail must have the correction for stationing as given in (22). The correction is

$$\frac{\frac{1}{2} g \sin 0°40'}{T(0°40')} = 0.03$$

which may or may not be neglected, depending upon the requisite refinement of the work at hand.

In the condition equation for this case, the quantities $S\ N$ and $I\ S$ remain constant. From the previous equations

$$N = T(0°40') \sin 0°40' - U(0°40') \cos 0°40' = 0.0077$$

$$I = T(0°40') \cos 0°40' + U(0°40') \sin 0°40' = 0.9998$$

$$NS = 0.770 \qquad IS = 100.01$$

A No. 7 frog is to be used with frog angle $F = 8°\ 10'$. As a first trial, the lead on tangent track may be used, which is about 65 ft.; s will then be 165 ft. and accordingly the total angle $A + a$ is 0.0303 or 1° 45′.

$$M = U(1°45') \cos 0°40' - T(1°45') \sin 0°40' = -0.0015$$

$$J = T(1°45') \cos 0°40' + U(1°45') \sin 0°40' = 0.9993$$

$$sM = -0.248 \qquad sJ = 164.88$$

The left hand member of the condition equation (using the value 1°5′ for a) is 0.0810. The right hand member, using the above values, is 0.0803. By assuming the lead value 64.5 the right hand member is 0.0809 and the left hand member 0.0810. This should suffice and the proper stationing may be found for the frog point by applying the parallel curve correction. The radius is found from the equations given above.

Changes in Configuration Revealed by Superposing Photographs

A method used during the war for detecting military construction, camouflage and other operations through airplane observation, and also used to some extent in astronomy and physics, is described by M. H. Stillman in a scientific paper of the Bureau of Standards, soon to be issued, under the title "Photographic Method of Detecting Changes in a Complicated Group of Oobjects." Under this method, photographs are taken of the place or group under observation, both before and after the period during which a change may have occurred; the exposures are taken as nearly as possible from the same position, and the same camera and the same kind of plate should be used. Superposing a positive made from one of the exposures upon a negative made from the other (the two being made as nearly as possible of the same density), the two plates when held to light will show a field of practically uniform density where no change has occurred. The dark portion of the negative adds to the transparent portion of the positive in the same way as the transparent portion of the negative adds to the black portion of the positive. Where a change has taken place, however, the opposing depth of positive and negative will not match or balance exactly, and there will be a distinct departure from uniform density of the field.

Relining a Leaky Park Lake With Gunite

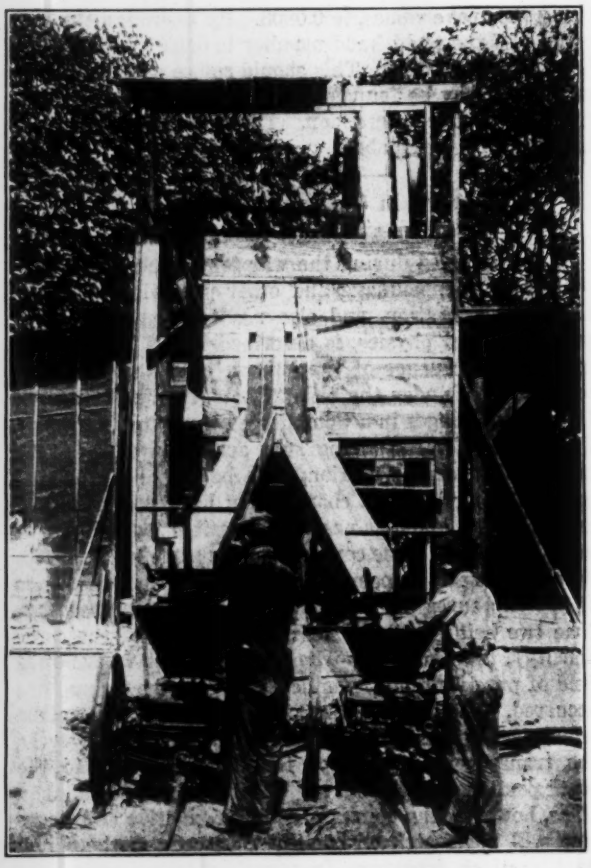
Mixing Plant Set Up on Shore and Concrete Applied As Far As 400 Ft. Distant—High Pressure Used

By Donald J. Baker
Wilkinsburg, Pa.

TWO inches of concrete applied with the cement gun and reinforced with a heavy wire mesh was used to reline the floor and sides of Lake Elizabeth, in West Park on the north side of Pittsburgh, Pa. The lake, which is a recreational center for boating, bathing and skating, has been leaking for some time through the 6-in. solid concrete base, though the depth of water is only 4½ ft.

The original bottom of the 200 x 550 ft. pond was a 6-in. concrete slab without reinforcement; three sides are on easy slopes with the same thickness lining and the fourth side was a low concrete wall. On this latter side, a new wall 10 ft. inside the old has been added in order to provide planting space for a shrubbery screen against a paralleling railroad.

When the water was drained off preparatory to relining the bottom, the exposed surface showed quite clearly that it was in an advanced stage of degradation. Cracks were numerous and in many places the concrete had worn away leaving small holes. Before the cement guns could be used, it was necessary to fill these cavities so that an approximately level surface would be provided for the placing of the wire reinforcement.



MIXED CONCRETE MORTAR CHUTED TO TWO CEMENT GUNS

APPLYING GUNITE UNDER HEAVY PRESSURE TO PITTSBURGH LAKE BOTTOM

Over 150 cu.yd. of mass concrete was used in this work, at the conclusion of which the bottom was thoroughly cleaned by brushing which removed all extraneous material.

It was desirable that this equipment be located as near the center of one side of the lake as possible so that the shortest hose lines could be utilized in reaching all portions of the bed. By reason of the nearness of the fence on the southwest bank, there was no space there available for setting up the guns and concrete mixer. A combination boathouse and rest room is situated in the center and near the bank on the north side so it was impossible to install the mixer at this point, which would have been the ideal location. Further, by reason of the flower gardens surrounding the building it was not feasible to situate the guns and other equipment in the immediate vicinity. A spot was finally chosen on the northeastern wall near the eastern extremity of the lake. Here two cement guns were installed as well as the concrete mixer and other storage piles.

No. 12 gage wire mesh was laid over the entire bottom in double layers, one being stretched over the other at right angles. In order to have the bed, slope and curbing one solid piece of concrete, the wire was laid not only over the floor but up the sides and over the curb.

After the wire had been placed over the bottom, the guns were brought into operation and hose lines extended from them to the nozzles, located some 400 ft. distant at the farthest point. The concrete used was a 1 : 3 mixture. This was delivered to the nozzles by air under a compression of 40 lb. per square inch. Water was delivered to the nozzles at a pressure of 160 lb. per square inch, which is considerably in excess of the pressure required for most efficient operation. A 2-in. thickness of gunite was applied.

That the completed surface might be relatively level and contain the grate desired to the outlet line near the southwestern corner, nails were driven in the floor at frequent intervals. These lacked 2 in. of being driven home, and provided a grade to shoot to. Of the three men stationed at the nozzles but one had previous experience with the cement gun; the other two were enlisted from laboring details, yet their work was quite up to the standard maintained by the experienced nozzleman.

After the curbing had been shot with gunite on both sides, a trowel was employed in producing a smoother finish, the stipple finish left by the gun being more or less rough.

Inclement weather delayed the work to some extent. Although the sand and cement was under cover in a roughly constructed building that housed the mixer at the guns, the dampness of the air penetrated these aggregates to such a degree that clogging of the hose to the nozzle often resulted. When this occurred, there was some delay before the long lines could be cleared, which was accomplished by shaking and pounding the rubber. Despite the handicap imposed by the weather, the nozzlemen averaged 1,000 sq.ft. of surface each per day of 8 hours. Over 2,800 bbl. of cement was required to gunite the 80,000 sq.ft. of lake bottom and sides while 175,000 sq.ft. of wire was employed in the reinforcing.

The work was done under the direction of the Bureau of Engineering of the Department of Public Works, N. Y. by A. V. Purnell, a Pittsburgh contractor.

Storing Coal at St. Louis Water-Works

WITH proper care practically all grades of bituminous coal can be stored indefinitely without material loss of heat value. This is the experience at the water-works of St. Louis, Mo., according to a statement made by L. A. Day, Engineer-in-charge, Operating Section, Division of Water, in a paper before the recent convention of the American Water Works Association. Continuing Mr. Day said:

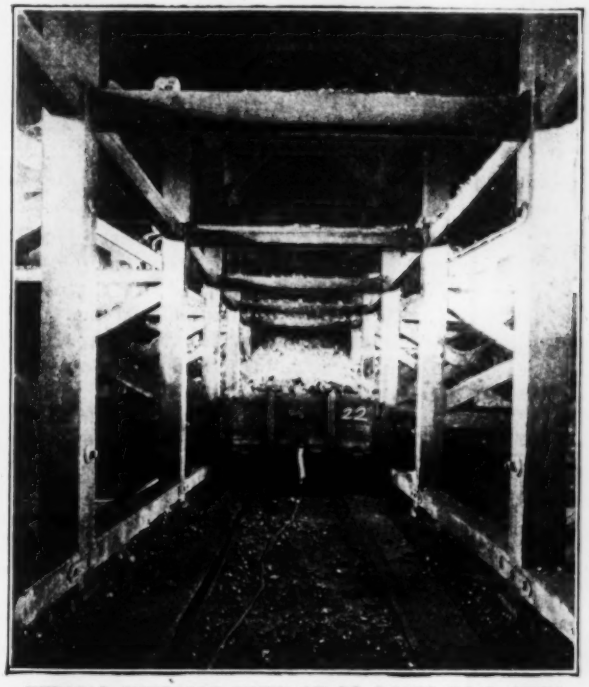
The water department is provided with a coal storage capacity of 15,400 tons, or enough for 60 days. Although we are close to the Illinois coal fields the wisdom of maintaining this liberal supply for emergency use has manifested itself on several occasions since the beginning of the war.

The coal stored is known as 6-in. screened lump. It is piled 16 to 18 ft. high in sheds.

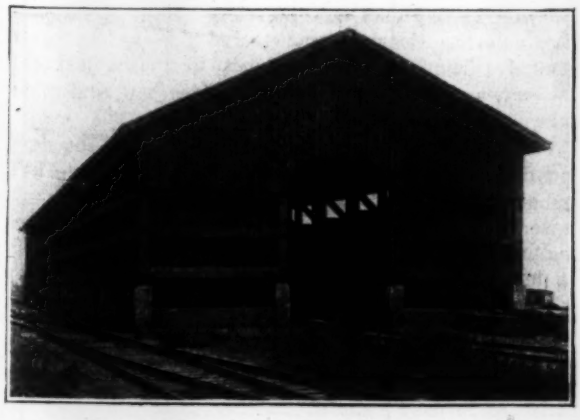
We do not attempt to store Illinois screenings for any length of time but have stored for a year Illinois screenings that contained about 45 per cent of duff coal that will pass through a screen having ¼-in. circular perforations. This coal showed no signs of heating after being placed in a pile about 6 ft. high in the open air, with no protection from rain or snow. In general, it has been our experience that all bituminous coal free from fines or duff can be stored for an indefinite period without appreciable heat loss. Heat value determinations show no appreciable heat loss due to storing for ten years. Naturally coal loses some of its moisture. This tends to compensate for the heat loss due to some of the volatile gases being set free.

It is preferable to choose sized lump coal for storing and the coal should be placed with the idea of minimizing breakage.

The accompanying views give an idea of the type of coal storage sheds used at St. Louis.



TYPICAL INTERIOR VIEW OF ST. LOUIS COAL SHED



EXTERIOR VIEW OF CHAIN OF ROCKS COAL SHED

Six Months of American Shipping

During the six months ending June 30, 1920, a total of 15,558 vessels, aggregating 86,931,700 dead-weight tons, entered and cleared United States ports. They carried 37,398,184 long tons of cargo. About 60 per cent of both vessels and cargo tonnage was chargeable to American registry. It appears from the figures that many of the American vessels carry return cargoes to American ports, while most of the foreign vessels enter in ballast. The latter, however, clear with relatively larger cargo. About half the total tonnage of vessels, and 60 per cent of the freight tonnage, was in export trade; here again over 50 per cent is credited to vessels sailing under the American flag. It is computed that the average export load of all vessels was 2,800 long tons, and the average import load 1,972 long tons, representing 52 and 34 per cent of the average dead-weight capacity per vessel. For 1919, a recent bulletin of the U. S. Shipping Board states, the shipping in export trade included only 46 per cent American and 54 per cent foreign bottoms.

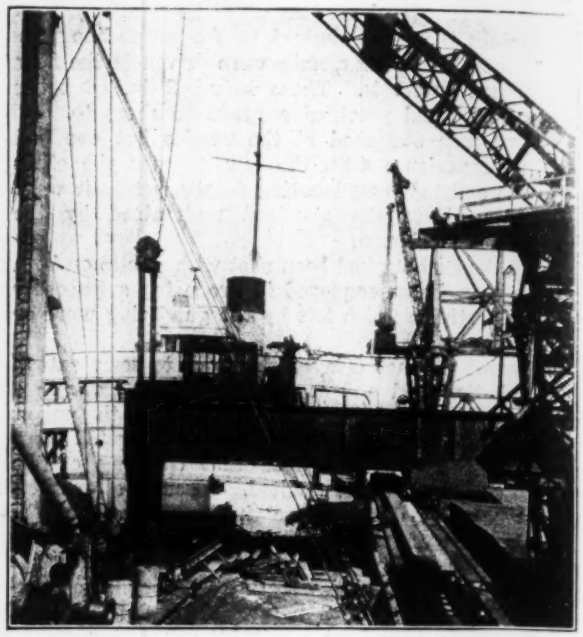
Mechanical Coal Trimmers Solve Ship Loading Problem

Installation at Curtis Bay Pier, Baltimore & Ohio Railroad, Increases Plant Capacity and Reduces Labor

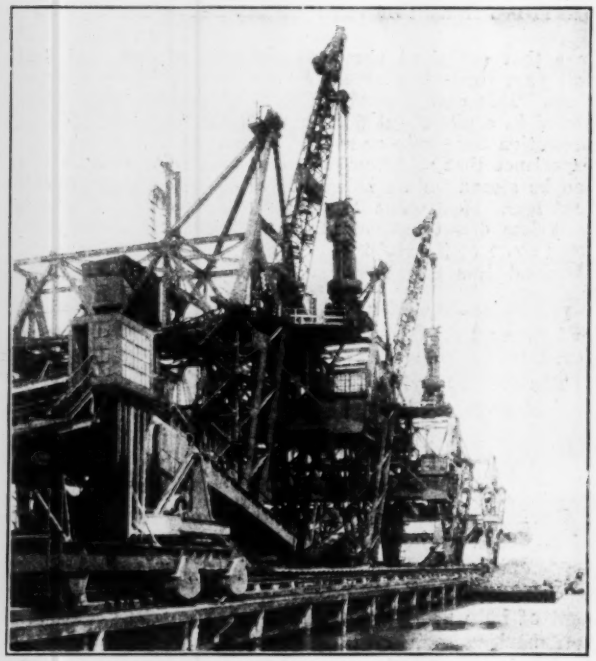
By Philip George Lang, Jr.
Assistant Engineer of Bridges, Baltimore & Ohio R.R.

TO PROVIDE the last step in the transfer of coal from cars to boats at the export coal pier of the Baltimore & Ohio R.R. at Curtis Bay, Md., the engineering department of the railroad has evloved and put into operation mechanical trimmers, resulting in a material increase in the handling capacity of the pier and a very large decrease in necessary labor. Hand trimming of boats having numerous small hatches and two or more decks involved the employment of large numbers of men, and when the labor situation became serious, upon the entry of this country into the World War, the impaired capacity of the pier and the high cost of trimming led to an investigation being made by the engineering department which resulted in the conviction that a machine could be designed and built which would satisfactorily supplant hand trimming.

The Curtis Bay coal pier, which was described in *Engineering Record* of March 17, 1917, p. 421, and in *Engineering News*, April 6, 1916, p. 656, is unique in that long conveyor belts are used for effecting the transfer of coal from ordinary cars to vessels. It was built in 1916 and supplanted a gravity coal pier, constructed by the Baltimore & Ohio during the '70's, which was outgrown by the demands of traffic. On the new pier two special McMyler car dumpers discharged coal upon four main conveyor belts. Four movable coal-loading towers carry transverse belts which receive the coal from the main 60-in. conveyor belt and discharge it into vessels, the transverse belts being capable of movement longitudinally of the pier to accommodate the various hatches of vessels, transversely to accommodate boats of varying beam, and vertically to compensate for varying drafts of vessels. Two years' operation has demonstrated a very large capacity as instanced by the recent loading of the SS Malden for the New England Coal & Coke Co., in which 7,222 tons of bituminous coal, which had been contained in 151 cars, were received in 1 hr. 58 min., which is believed to be a world's record for rapid loading.



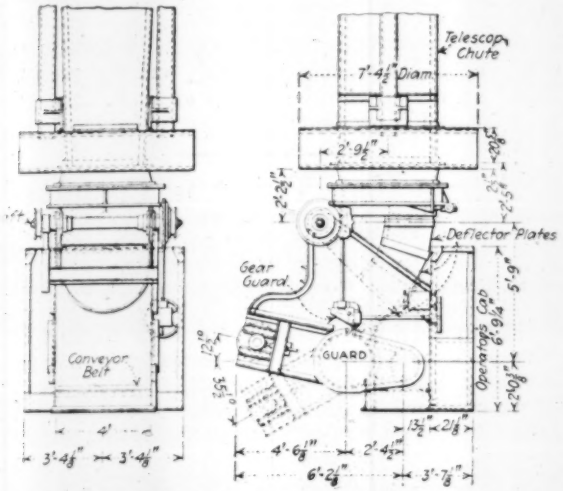
TRIMMER LOWERED TO OPERATING POSITION IN HOLD OF SHIP



MECHANICAL COAL TRIMMERS RAISED AND LOWERED BY BOOM SUPPORTS

The pier was highly satisfactory when so-called "open" boats, requiring little or no trimming, were to be loaded; but with boats having numerous small hatches and two or more decks it became necessary to resort to hand trimming involving the employment of a large number of men to shovel the coal by hand between decks to the more or less remote parts of the vessel. This condition caused the cost of loading per ton of coal to rise very rapidly and materially decreased the capacity of the pier, for the reason that, while the boats were being trimmed by hand when berthed, the plant was idle. Experience at Curtis Bay and at other ocean terminals has clearly demonstrated the inadequacy of manual trimming as an adjunct to mechanical coal delivery, and has shown that it involves long and costly delays to vessels.

The mechanical trimmers, developed by the engineering department of the railroad company during 1918, embody the principle of an endless belt to which bulk material is delivered through a telescopic chute of four sections, and distributed by the movement of the belt at high speed. Coal is delivered at the top of the telescopic chute by the shuttle belt of the transverse coal pier unit. In the design of the trimmers it was attempted to secure a speed of the continuous belt which would give the maximum throw and at the same time correspond approximately with the velocity attained by the coal in its descent from the shuttle belt



DETAILS OF NEW COAL TRIMMER

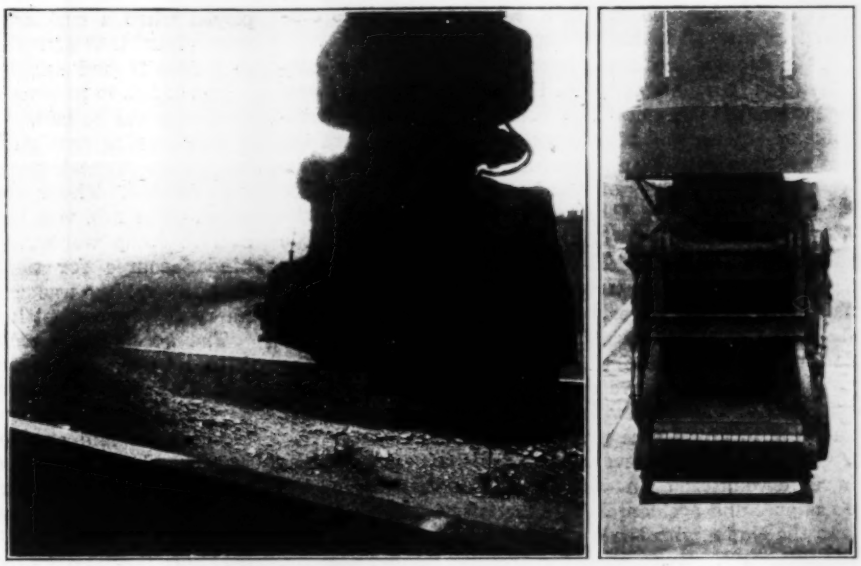
when directed by properly placed deflecting plates to the endless belt.

The telescopic chute has a minimum cross-sectional area of 2 ft. 9¾ in. x 3 ft. 2¾ in. The greatest distance from the top of the cross belt delivering coal to the chute to the top of high-speed trimmer belt is 44 ft. 3 in., and the minimum, 23 ft. 6 in. with the chute completely telescoped, so that allowance is made for varying drafts of vessels and more than one deck in trimming.

The angle of the trimmer belt may be elevated by means of a mechanism consisting of a ratchet wrench driving a worm wheel through a shaft and meshing with a gear segment on a lever arm carrying the belt frame. The endless belt is also capable of rotation through a complete circle accomplished by a 13-hp. direct-current motor driving a motor pinion, engaging gear, which drives a worm and worm wheel and pinion engaging a rack.

A limiting factor which presented a serious obstacle in the development of the design was the restricted hatch areas of oceangoing vessels. The machine as built has an extreme horizontal dimension of 7 ft. 6 in. x 10 ft. 0 in. In this small space a mechanism had to be developed capable of imparting to the material handled an initial velocity adequate to the proper discharge. The distance to which bulk material must be thrown in order properly to fill the holds of various types of oceangoing vessels became the object of consideration and much time and study were devoted to plotting the trajectories of material thrown at different angles and various speeds. To attain the desired range in the throw of coal it was found necessary to attach cross cleats to belts, in spite of the fact that coal is delivered to the end of trimmer belts at comparatively high velocity. These cleats are thoroughly protected by metal to reduce wear, as indicated in the photograph. The belt has a width of 48 in. and a distance center to center of the 18-in. pulleys of 3 ft. 9 in., running at a velocity of approximately 2,700 ft. per minute. The power for operating the trimmer belt is provided by a 40-hp. direct-current motor connected to the endless chain pulley by a chain drive, protected by metal housing. Elaborate provision is made throughout the trimmer to protect all mechanism from dust.

It was necessary to give careful attention to the method of supporting the trimmers since their weight is approximately 22 tons each. The trimmer had to be movable so that it would not interfere with the movement of boats alongside the pier and had to be held steady in heavy winds, as well as being capable of being quickly lowered to operating position, securely attached to the loading tower. The accompanying photograph shows one machine in the housed position, and another in operation in the hatch of a vessel. Vertical pipes



LEFT, TRIMMER DISTRIBUTING COAL IN BARGE. RIGHT, BELT WITH CROSS CLEATS THROWS COAL OUTWARD

which resist the reaction of the flow of coal and the lateral wind forces are used to support the trimmer from the cables passing over the boom. In a loading position, the weight of the lower portion of the machine is held by the boom through the ropes and vertical pipes, while the telescopic chute section is held by brackets placed on top of the cross girder. The lower brackets on the end of the cross girder are so designed that they do not take vertical loads, but prevent lateral movement. It is possible to move from the completely housed position into loading position, in the hatch of a vessel, in approximately 3½ min. The operator is stationed at the rear of the trimmer itself and is so able to closely guide its operation, accompanying it into the hold of a ship.

The first of the trimmers was placed in operation Dec. 27, 1919, when 1,000 tons of petroleum coke were delivered to the SS Victorious. The last of the four trimmers was installed April 9, 1920. Up to the present time the four machines have handled over 1,000,000 tons

of coal under practically incessant operation and the most severe demands.

The practicability of the trimmers has been established by investigation and analysis of cost elements. On March 21 and 22, 1920, the SS Scotsburg, a ship with five hatches and four 'tween decks, was loaded with 9,600 tons of coal in 9 hr. and 30 min. It is estimated that 25 hr. would have been required if hand trimming had been employed.

The accompanying photograph, which was taken in the open on a barge for the reason that it is impossible to obtain a photograph of the trimmer when working within the hold of a vessel, shows the machine throwing coal at the rate of approximately 17 tons per minute.

The result of the successful operation of the four mechanical trimmers, two on each side of the pier, has been to change this pier from a four-boat pier to a two-boat pier, the most efficient operation being obtained when the mechanical trimmers are used to their fullest extent in one boat on each side of the pier; that is, the material is deposited in the vessel as fast as it is conveyed to the mechanical trimmers.

Undoubtedly, the most important element for consideration in connection with the cost of trimming coal by the use of mechanical trimmers, both from the standpoint of expense and of efficient operation, is that of the service or life which is obtained from belts. Service tests of various types of belt have been made, and the data obtained are well worth the effort. A material reduction in the cost of belt per ton of coal handled, the largest of the mechanical trimming cost elements, has been effected, but the accumulation and analysis of belt data have not as yet reached the point where the writer feels that the full possibilities of this portion of the device have been realized. The general results so far obtained, however, have demonstrated beyond all doubt that the trimmers now in use at Curtis Bay are far superior to any device previously evolved.

One of the most severe tests which these machines have encountered in actual service has been the occasional and accidental introduction of foreign bodies into the chute, with the coal, and their passage through the trimmers. In addition to car knuckles and springs, these articles include a piece of iron 2 ft. wide by 3 ft. long, weighing approximately 500 lbs., and, in two other instances, large pieces of stone, weighing respectively 500 and 600 lbs., which passed through the machine without causing damage. On another occasion, a steel car strut, approximately 8 ft. long, 10 inches wide and 4 inches thick, found its way to the trimmer belt and passed over the machine.

While every possible precaution is observed to prevent the intrusion of such material into the chute, the fact that the trimmer has, on several occasions, discharged objects of this nature without damage to itself is a striking illustration of the sturdiness of these machines and their ability to withstand hard usage.

The development of the machine was carried out by the engineering department of the Baltimore & Ohio R.R. under the immediate direction of the writer, including the preparation of general plans and supervision of the structural and mechanical details as these were developed by the engineering department of the McMyler Interstate Co. which fabricated and erected the trimmers. The device, patents for which are now being secured, will be known by the trade name of the "Lane-Galloway" trimmer. The installation of a machine of this nature was recommended by C. W. Galloway, vice-president of the railroad company, and the work was placed under the general direction of H. A. Lane, chief engineer, and W. S. Bouton, engineer of bridges.

Syracuse Uses Tar-Sand Cushion in Wood-Block Paving

By John Stanley Crandell
Consulting Engineer, General Tarvia Department, the Barrett Company, New York City

THE wood block pavement on East Water Street, Syracuse, N. Y., was laid recently in a manner somewhat different from that usually followed. In place of a plain sand cushion, or a cement-sand cushion, a tar-sand cushion was spread and the blocks were laid thereon. While this method has been used to same extent by street car companies it has not been given an extensive try-out in city work.

The concrete base was given the finish usually employed when a cushion coat is to be laid over it. It was evident that a number of people had walked through it before it had set, and therefore there were areas where it had to be smoothed up with a pickax before the cushion could be laid.

The cushion consisted of dry sand and light refined tar, in the proportion of about 90 per cent sand and 10 per cent tar. These were mixed cold in a local asphalt plant. The mix was brought to the job in the regular bottom dump wagon, spread and raked as if it were binder course for a sheet asphalt pavement, except that the raking was easier, and there was no need to hurry to prevent setting up or cooling.

The specification called for a depth of cushion of ¾ in. Owing to the irregularities of the base, mentioned above, the depth varied from ½ in. to 1½ in., but on the whole it probably was close to specification. The blocks were laid on the unrolled cushion. After they were in place, and the culls had been removed and replaced, the pavement was rolled with a light tandem roller. The joints were filled with coal-tar pitch, and the surface was sanded. It was not possible to roll the cushion; the tarred sand stuck to the roller.

There are some decided advantages about this method of construction. First of all, an absolutely waterproof cushion is provided for the blocks. Water can neither find its way up through the cushion nor can it seep through from the surface. With a pitch filler in the joints there should be no danger of any bulges or blow-ups from moisture causes. There can be no shifting of the cushion from entrance of water or other causes. This cushion of tar and sand sets up after a while into a firm but resilient mat. The cost is low.

The amount of tar will vary with the quality of the sand. The writer made an extended series of tests in 1912, 1913, 1914, and 1915 to determine the right amount of tar to use. In all he tested over 1,200 briquets of tar and sand mixtures and the strongest were those that contained between 7.5 and 11 per cent of tar, by weight. The coarser the sand the less tar necessary, but a minimum of 7.5 per cent should be set. Less than this amount produces a mix that will not hold together. At the present writing there are no recommendations to make as to how to determine the correct amount to use other than to state that a fine asphalt sand will require about 10 per cent of tar, while a coarse building sand will require less.

The History of Engineering

By C. Matschoss
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In an article published in this journal Feb. 12, p. 322, R. Fleming urged the importance of compiling a history of engineering. Many of the data for such a history, in this country more so than elsewhere, are rapidly becoming lost. Over twenty years ago the same thoughts stirred a young German engineer, Conrad Matschoss, to attack the problem singlehanded. His first historical monograph gained the interest and help of the national engineering society, and later led the Charlottenburg Technical College to found a chair of Engineering History, of which he is the first incumbent. In order to acquaint those who will write America's engineering history with what has been done elsewhere, Engineering News-Record *asked Prof. Matschoss to tell briefly of the development of his historical work. The present article is his response. In transmitting it he says: "Every step of progress in this field made in the United States will tend to further our own endeavors. We European engineers can wish for nothing better than to see the excellent suggestions of Mr. Fleming put into effect." —*Editor

WHOEVER should attempt, 5,000 years hence, to reconstruct our present age by the help of our present day historical records, would find only stories of presidents and kings, of the mistakes of our diplomats and of the deeds of our great generals. Of the real essence of our age, of engineering, which has revolutionized our life and by means of which the United States of America has acquired its dominating position in the world, the seeker after truth would learn very little.

The great men of engineering science have molded the history of their age, but in doing so they found no time to write this history. Our historians know too little about engineering to comprehend our age or do it justice. Therein lies a reason for the remarkable fact that our scientists know a great deal about the tools of the stone age, but very little about modern tools, and yet no greater proof of the glory of American engineering during the last fifty years could be adduced than the history of American toolmaking.

It will be necessary for engineers to write their own history, but this history will in reality be nothing less than the history of a nation of workers. If that history were written we would be able to recognize plainly how much we owe today to whole generations of inventors and engineers in all countries. Often these great pioneers of engineering would appear to us more deserving of praise than the modern statesmen and warriors, upon whom history is wont to lavish its laurels.

The vast amount of research work to be done in the field of engineering can only be realized by one who has selected historical research work as his special study. It has been my privilege to be engaged in this work since 1895, and in 1901 I published a history of the steam engine, in which I endeavored to treat this important subject in a manner which would appeal to everybody. When I had finished this work I found that it was only a beginning, and that a systematic study of this matter was only possible after I succeeded in obtaining the assistance of the Institute of German Engineers. This great engineering institution opened for me the archives of the government and of the great engineering factories; it gave me introductions to prominent engineering firms, and allowed me to travel extensively. Everyone I came in contact with evinced an intense interest in my work, and many thousands of original drawings were willingly placed at my disposal, dating back to the beginning of the 18th century. In this manner, in 1908, I completed my book on the "Development of the Steam Engine," in two volumes, being a history of the stationary steam engine, the locomobile, the marine engine and the locomotive.

This work was so favorably received that the Institute of German Engineers decided to entrust to me the task of historical research and the regular publication of a periodical under the title *Contributions to the History of Engineering and Industry.* This publication, which is devoted exclusively to the history of engineering, first appeared in 1909, and since that time has been published regularly. Up to the present there are nine volumes, containing important contributions referring to all ages and to the most varied countries and topics. The biographies of prominent engineers and the history of industrial and engineering enterprise have been fully treated. In the same year I received a call for filling the newly created chair of Engineering History at the engineering university of Charlottenburg.

Sources of Information

Doubtless the history of the engineering science of bygone ages is very fascinating and important. It is more important for us, however, to discover the sources of the history of engineering of our present age and to keep a systematic record of them. Whatever we neglect to do in this respect now will be irretrievably lost. Those of our great engineers, still living amongst us today, who have been the creators and pioneers of the particular branch of engineering they represent, are sources of information which we cannot dispense with. The great engineering societies should stimulate these men through the medium of the great engineering press to leave their memoirs to posterity.

What a vast store of historical engineering information is contained in the autobiographies of Werner Siemens, Henry Bessemer, Charles T. Porter and many others! In Germany we are at present endeavoring to work systematically in this direction. Long historical conversations with prominent engineers are taken down by shorthand writers and supply much important material which, entrusted to the archives of the Institute of German Engineers, forms a valuable contribution to the history of engineering. There are many industrial concerns which, on the occasion of a jubilee celebration, happen to remember that they have a history to be proud of, and then proceed to write an account of the historical development of their works, based on the data contained in their own archives. In this manner historical works have been produced that are a mine of information for the historian specializing in the history of engineering and industry.

Engineering Museum Established

Such endeavors received an extraordinary stimulus in 1903 through the establishment of the "Deutsche Museum," the German museum for masterpieces of natural science and engineering in Munich. Oscar von

Miller, the well-known electrical engineer, a friend of the famous inventor Thomas A. Edison and honorary member of the American Society of Mechanical Engineers, succeeded in an incredibly short time in compiling a collection of historically remarkable productions of engineering, which were admired by the whole world. This collection was received with such widespread approval that the necessary funds were quickly placed at the disposal of Mr. von Miller. When it became my privilege to visit the Munich Museum with 200 American engineers I found among them the fullest possible understanding of the importance of the history of engineering. They pointed out to me in what high degree such a museum is adapted for stimulating interest in great engineering work amongst the masses of the people. In this museum the portraits of the great engineers and scientists are placed close to their masterpieces, thus inspiring the onlooker with that enthusiasm which alone is productive of great accomplishments.

When will the great Museum of Engineering be started in America? For anyone who knows the importance of engineering it is a great pleasure to see that in the National Museum in Washington the famous Stevens marine engines and many other masterpieces of engineering are accorded equal prominence with other exhibits. What Paris can boast of in its Conservatoire des Arts et Métiers, London in its Kensington Museum, and Munich in its German Museum will surely in no distant future be emulated by a country which has risen into prominence with steamships and railways and through engineers who are famous throughout the world.

The science of engineering is not confined to the boundaries of any one country, and as in Munich the masterpieces of the different nationalities are placed peacefully side by side, so the future great American Engineering Museum will no doubt bear testimony to the fellowship of all engineering and scientific research workers. This museum would be destined to become the center, in America, of all systematio historical research work, and to the great and influential enginering institutions this will be a gigantic common task for the common good of the profession.

If the enterprising spirit of American engineers is once directed into channels for systematically furthering the history of engineering we shall all benefit enormously in every other country. Nowhere is competition more desirable than in this field, for it aims at bearing testimony to the work of our great engineers and arousing enthusiasm in those who wish to become engineers. Without this enthusiasm in the growing generation of engineers we shall never succeed in rebuilding this world and making it better than it has been before.

Philadelphia Municipal Pension System

A pension system for all municipal employees has been in effect in Philadelphia since July 1, 1915, following a legislative act of the year named. Employees who have reached the age of 60 years and have been 20 years in the service of the city are entitled to a pension equal to one half their average salary or wages received during their term of service. Employees contributed 2 per cent of their wages or salary to the pension fund, but not to exceed $4 a month. This pension scheme does not include policemen and firemen, who have a separate pension fund.

Lumber Depletion in the United States

IN a report to the United States issued under date of June 1, 1920, the Forest Service of the United States Department of Agriculture comes to certain conclusions regarding the present status of the timber supply in this country. The outstanding facts are that three-fourths of the original timber of the United States is gone and that we are using timber four times as fast as we are growing it. The forests remaining are so localized as greatly to reduce their national utility. The bulk of the population of manufacturing industries is dependent upon distant supplies of timber as a result of the depletion of the principal forest areas east of the Great Plains. The depletion of timber is not the sole cause of the recent high prices of forest products, but it is an important contributing cause whose effect will increase steadily as depletion continues.

The Present Problem

The fundamental problem today, according to the bulletin, is to increase production of timber by stopping forest devastation. At one time the virgin forests of the United States covered 822,000,000 acres. They are now shrunk to one-sixth that area. All classes of forest land now aggregate 463,000,000 arces. Of the land remaining not utilized for farming approximately 81,000,000 acres have been so severely cut and burned as to become an unproductive waste. New timber remaining in the United States is estimated roughly at 2,215 billion board ft., three-fourths of which is in virgin forest; the rest is the second growth of relatively inferior quality. About one-half the timber left is in the three Pacific Coast states, and over 61 per cent is west of the Great Plains. A little over one-fifth of the timber left in this country, or 460 billion board ft., is hard wood. There is now consumed or destroyed annually 56 billion board ft. of material of saw timber size. The total yearly consumption of all classes of timber is about 26 billion cu.ft., and the depleted forests are growing less than one-fourth of this amount.

According to the report of the Secretary of Agriculture the solution of the problem presented by this forest situation is a national policy of reforestration. Increase of widely distributed production of wood is the most effective attack upon excessive prices and monopolistic tendencies. Depletion has not resulted from the use of forests but from their devastation. It is recommended, therefore, that legislation be enacted which will permit effective co-operation between the Federal government and the several states in preventing forest fires and growing timber on cutover land, and which will greatly extend the national forests.

A statement is made that can be construed as giving as the opinion of the Department that profiteering has been rampant in lumber selling. "A study of prices and increased production and distribution costs during the pre-war and post-war periods substantiates the statement that prices during the end of 1919 and the beginning of 1920 reached costs unjustified by production and distribution costs. Irrespective of the distribution of excessive profits, which by and large unquestionably varied with relative advantages held and with relative abilities to dominate situations, lumber prices are excessive and yield profits bearing no reasonable relation to increased cost of lumber production and distribution."

Testing Rock Bearing By Leverage Loading Machine

Device Used at New Sacramento River Dam by Reclamation Service Engineers Proves Successful

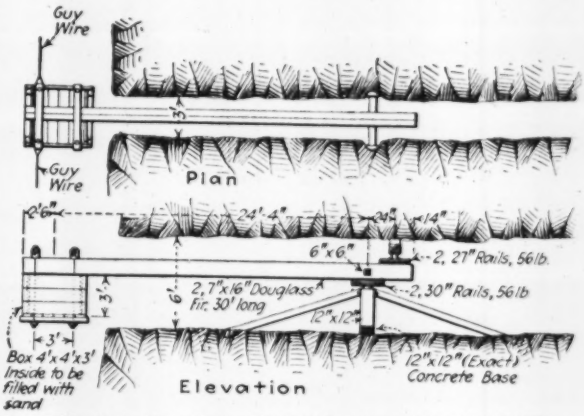
BEARING capacity of rock is as a rule most difficult to measure by any simple field testing machine. In the investigations for a new dam at Iron Canyon, on the Sacramento River, however, the engineers of the Reclamation Service used such a machine with success. Its details and the results of the tests are described as follows by H. J. Gavit, Engineer, U. S. Reclamation Service in the August, 1920, number of the *Reclamation Record*.

The site for the dam is in a region where the rock formations are all of volcanic origin. These include tuffs, breccias, agglomerates, and basalts. Of these classes the one most suitable for foundations for a dam is the agglomerate, and the location of the dam site was governed mainly by the consideration of finding a place in the canyon where this formation is of sufficient thickness under the river to provide a safe foundation. At the site selected the agglomerate lies in a nearly horizontal sheet or bed about 140 ft. thick, of which about 110 ft. is beneath the river bed.

This rock is composed of volcanic sands, ash, and large and small fragments of lava, mixed and cemented to form a sort of natural concrete of varying hardness. In drilling this material with a core drill few samples were obtained except from the lava blocks, the body of the mass being generally too soft to produce solid cores. There is no stratification or regularity in the formation, the softer parts occurring in irregular masses or pockets. For the purpose of examining this rock more closely a drift or tunnel was excavated into a cliff near the dam site. This tunnel was about 3 x 6 ft. in size and 35 ft. in length. It penetrated both hard and soft material, the latter in places being soft enough to be excavated by a pick without blasting.

Before planning a high masonry dam to rest upon this agglomerate rock it was desirable to know its bearing capacity or supporting power, and to this end a test was made in the tunnel by applying varying degrees of pressure upon an area of 1 sq.ft. on the floor of the tunnel at a point where the softest material was found. The apparatus for making the test consisted of a simple beam or level 30 ft. long bearing on the roof at one end, with a weight applied at the other. The short arm was 2 ft. and the long arm 24.4 ft. Concrete blocks 12 in. square and 3, or 4 in. in depth were molded on the roof and floor at the points of bearing. The beam was of Oregon fir, 14 x 16 in., formed by two pieces 7 x 16 in. bolted together. The weight used was a wooden box 4 x 4 x 3 ft. inside, filled with sand. Short sections of 56-lb. steel T-rail were used in combination with 12 x 12 in. pine blocks to concentrate the pressure at the proper points on the beam. In the joints between the wood and concrete blocks at the roof and floor steel pointers were inserted, extending about 3 in. to a vertical graduated scale attached to a frame fastened to posts which were set farther back in the tunnel so as to be unaffected by the application of pressure. By this arrangement a movement of the pointers along the scales would indicate the yielding or compression of the rock.

As a check on the results levels were carefully taken on both roof and floor blocks before and after the test. Five readings were taken on each block and referred to two bench marks before the test and another set of readings at the same points was taken after the test. These level readings showed no measurable settlement or compression at either block. The indicator at the floor block, however, showed a settlement on the scale of ⅛ in. This result was discredited for the reason that the arrangement of the indicator was such that the progressive pressure may have caused a slight twist in the pointer, and the results of the level readings were considered much more reliable.



DETAILS OF ROCK BEARING TESTING MACHINE

Following is the record of the pressures and corresponding gage readings:

Test Conditions	Roof Block Pressure Tons	Roof Block Gage Inches	Floor Block Pressure Tons	Floor Block Gage Inches
At start, before applying pressure		15.25		2.375
With beam and empty box	7.6	15.25	8.8	2.325
Weight box partly filled	20.0	15.25	22.0	2.310
Weight box filled	33.3	15.25	36.5	2.250
With extra weights added	36.0	15.25	39.5	2.252

The limit of pressure for the apparatus was reached at 39.5 tons. What additional pressure the rock would have supported is not known.

The level readings showed no actual settlement of the floor block as a whole, but indicated a slight tilting of the block which was accounted for by the small movement of the beam and post during the process of loading. The conclusion therefore was that there was no measurable yielding at either the roof or floor block.

Applying the result of the test to the design of the dam it is recognized that the conditions are not quite similar for the reason that in the test the load is applied at the top of a pyramid of pressure, whereas under the dam it is applied at the top of a theoretical column of uniform thickness. Taking into account this difference in conditions, since the material stood under nearly 40 tons per square foot without yielding it is considered safe to design the dam with pressure on the foundation not to exceed 10 tons per square foot. All pockets of soft material exposed in preparing the foundations should, however, be excavated so as to leave a surface of the harder rock.

Duluth Plans Crossing of Canal

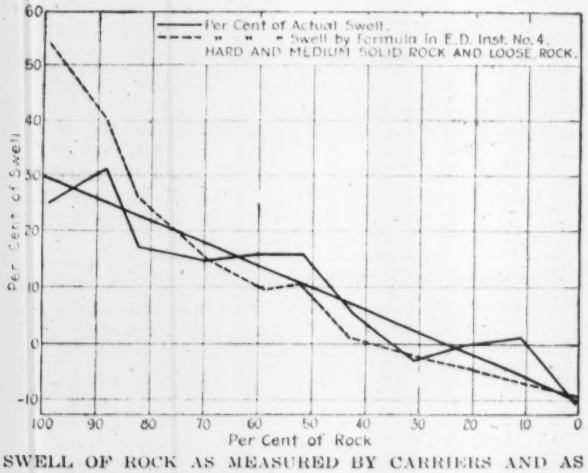
Traffic over the aerial bridge which spans the ship canal across Park Point and forms the entrance to the inner harbor at Duluth, Minn., has increased to such an extent that alternative plans have been made by E. K. Coe, city engineer, for drawbridge and tunnel projects to afford adequate facilities for passengers, street cars and roadway vehicles, and possibly for railway tracks also. Any kind of bridge is opposed by the Lake Carrier Association and the U. S. War Department. A tunnel would require a steep approach and its cost is estimated roundly at 72,000,000. No action has been taken, but an improved crossing is needed on account of the traffic and to enable the six miles of waterfront on Park Point to be developed for docks and warehouses. This district is said to be well able to sustain reasonable expense to provide communication. The aerial bridge or ferry bridge was built in 1904 and was designed for trips at intervals of 20 to 30 minutes for the car suspended from a 393-ft. span high enough to clear vessels. The contract price was $100,000, but this included the design. The operating and maintenance cost has been $193,000 during 15 years of service.

Shrinkage and Swell of Materials In Railway Fills

Carriers' Report Includes Results, Covering Many Rock and Earth Materials, Obtained from Actual Measurement

Abstract of Subcommittee Report, Presidents' Conference Committee, Federal Valuation of the Railroads of the United States, heretofore unpublished.

A SHRINKAGE in railway embankments composed entirely of earth approximating 10.4 per cent of the original volume in cut, and, in embankments composed entirely of rock, an average swell of 30 per cent are indicated in the conclusions of a report recently made to the engineering committee of the Railway Presidents' Conference Committee by a subcommittee consisting of D. J. Brumley, chairman; H. E. Hale and Charles Silliman. The report states that the allowance for shrinkage in earth embankments should not be less than 10 per cent and the results obtained indicate that, with increasing proportions of rock, shrinkage decreases rapidly and swell takes place in material of more than 40 per cent rock.



SWELL OF ROCK AS MEASURED BY CARRIERS AND AS CALCULATED BY INTERSTATE COMMERCE COMMISSION

The subcommittee was appointed to investigate and report on the subject of shrinkage and swell of material in embankments with respect to the instruction issued by the eastern district of the Valuation Bureau of the Interstate Commerce Commission, as follows:

"Where grading involves classified materials the ratio of measured volume of embankment to that in excavation, where better evidence is lacking shall be used on the following swell factors applied to the excavation measurement. For hard solid rock and loose rock (boulders or detached masses), 60 per cent; for medium rock and loose rock other than boulders or detached masses, 45 per cent; for soft rock, loose of the same character as to hardness and hardpan, 10 to 25 per cent; earth or common excavation, 10 per cent shrinkage."

Accompanying this instruction quoted above were charts showing the swell or shrinkage for fills composed of varying proportions of rock and earth, the latter filling to some extent the voids of the former. It seemed to the committee that the best way of testing the accuracy of the charts was to compare results obtained by its use with the swell determined by measurements of various combinations of material encountered in actual construction. Railways were requested to furnish information as to swell of rock and to make cross section surveys of embankments, preferably those abandoned at the time of construction, where the quantities from which they were built could be identified in the records. This applied only to ten jobs out of all those reported. Eight of these lines were the Vermont Central and two were Illinois Central jobs. These ten jobs were cross sectioned on lines which were abandoned during construction. All of the others were on operated lines. The total returns represented 12,000,000 cu. yd. of excavation and the general results are shown in Table I taken from the report, which was compiled from the accompanying chart.

TABLE I. SWELL AND SHRINKAGE OF MATERIAL IN RAILWAY FILLS OF EARTH AND ROCK

Proportion—Rock Per Cent	Proportion—Earth Per Cent	Swell or Shrinkage	Result by Measurement, Per Cent	Result by Valuation Rule Per Cent
100	0	Swell	25	54
90	10	Swell	31	40
80	20	Swell	17	26
70	30	Swell	15	15
60	40	Swell	16	10
50	50	Swell	16	11
40	60	Swell	6	1
30	70	Shrink	3	2
20	80	Shrink	0.1	4
10	90	Shrink	1.2*	7
0	100	Shrink	10.4	9

* Swell.

In connection with this table the report points out that where the proportion of rock is more than 60 per cent the instruction from the Bureau of Valuation provides a greater swell than that indicated by the measurement of known cases, but that where the proportion is less than 60 per cent the rule gives a smaller swell than that indicated by the measurements. From a study of the records covering about 12,000,000 cu. yd. it appears that a maximum allowance of 30 per cent for swell is representative of actual experience where the banks are comparatively new, the allowance decreasing with the decreasing proportions of rock.

The committee reports that the rock fill records consist largely of cases where the measurements were taken during or shortly after the completion of construction. It expresses the opinion that with some kinds of rock in the course of years disintegration will take place, filling the voids and thus reducing the volume of the mass. This opinion is confirmed by the few cases of measurements of old fills. For this reason the committee considers that with old embankments containing 40 per cent or more of rock great care should be exercised in determining the percentage, as with many materials the actual swell will be less than the percentage given in Table 1. In Table II are shown some of the individual records of shrinkage in rock and earth of different kinds.

As to shrinkage of earth embankments, the report states that the records obtained show that such embankments "shrink in all cases from the dimensions of the original excavations," the average shrinkage in the cases reported being 10.4 per cent as indicated by the 12,000,000 cu. yds. involved. This matter has been given prominence by the brief of the Public Utilities Commission of Illinois (in connection with the valuation of the Elgin, Joliet & Eastern Ry.) that no allowance should be made for shrinkage in earth embankments. On the other hand, the practice of the Bureau of Valuation of the Interstate Commerce Commission has

TABLE II. SHRINKAGE OF EARTH AND SWELL OF ROCK IN RAILWAY FILLS AS DETERMINED BY ACTUAL MEASUREMENTS AND BY THE RULE OF THE BUREAU OF VALUATION

Railway	State	Material	Shrinkage by Measurement, per Cent	Shrinkage by Rule, per Cent	Method of Construction	Quantities Involved—(Excavation) Cu. Yd.
...n. Vt.	R. I.	Fine, dry, sand	7.77	9.1	A	96,767
...n. Vt.	R. I.	Stiff blue clay	12.27	9.1	A	3,042
...l Cen.	Ill.	Dune sand, fine and dry	8.81	9.1	A	358,408
...o. Pac.	Ore.	Borrow earth, very clayey	1.8	9.1	B	11,016
...o. Pac.	Ore.	Silt and coarse, hard gravel, mostly borrow; bottom of large fill	10.3	9.1	B, C, D	64,160
...o. Pac.	Ore.	Clayey silt	11.1	8.7	A, C	9,648
...o. Pac.	Ore.	Clayey silt, gravelly in spots, half cuts and half borrow	10.1	9.1	B	31,660
...o. Pac.	Ore.	Very clayey, mostly cuts	3.5	9.1	C, D	5,572
...o. Pac.	Ore.	Cemented material, clayey in character; mostly cuts; 2.5% rock in fill	15.1	8.6	E, F	26,781
No. & West.	.....	Light clay with considerable sand and some mica	8.8 to 9.7	9.1	C, D	124,069
No. & West.	.....	60 per cent dry sand	6.1	9.1	C, D	44,360
No. & West.	.....	Some quicksand	10.3	9.1	C, D	77,120
		ROCK FILLS				
			Swell by Measurement	Swell by Rule		
L. & N.	Ala.	Hard limestone	55.9	60		13,782
L. & N.	Ala.	Shale and sandstone	20.6	45		155,000
...n. Pac.	Utah	Hard rock	21.0	60	A, C	30,862
...n. Pac.	Wyo.	Medium hard rock	9.9	45	A, C	6,215
Cen. Vt.	Mass.	Granite	31.9	60	D	8,762
Colo. So.	Colo.	Granite	48.4	60	E	3,596
Mo. Pac.	Ark.	Hard limestone	24.8	60	B	23,053
Mo. Pac.	Ark.	Very tough limestone	32.6	60	B	25,955
Mo. Pac.	Ark.	Hard slate, disintegrating on exposure	10.2	44.4	B	69,211
So. Pac.	Ore.	Very hard trap in tunnel	90.1	60		9,444
So. Pac.	Ore.*	Trap and other rock, mostly tunnel; 1.1% earth in fill	45.5	58.2		41,405
C., M. & St. P.	Wash.*	Hard basalt; 2% earth in fill	46.0	56.8	F	10,660
C., M. & St. P.	Wash.*	Hard basalt, 2.5% earth in fill	66.6	56.0	F	31,205
Ch. & O.	W. Va.	Hard sandstone	35.1 to 45.3	60.0		54,211
Ch. & O.	W. Va.	Hard sandstone and shale	23.3	57.8		190,582

* Earth is included with rock in small proportions in these three cases.

NOTE—Methods of construction (see last column): (A) Unloaded from temporary trestle; (B) Teams and scrapers; (C) Steam shovel; (D) Dump wagons; (E) Carts and horse-drawn cars dumped from sides and ends of fills; (F) Station men.

been to add an allowance of 10 per cent to the measured embankment quantities in computing pay quantities, which is the equivalent of assuming that the shrinkage from the excavated quantities is 9.1 per cent, as compared with a shrinkage of 10.4 per cent indicated by actual measurements of railroad construction.

Railroad grading is paid for usually by measurements of excavation (one way method) or by an allowance of the quantities within the dimensions of the standard roadbed section, both cut and fill (two way method). In the construction of embankments, allowance is made for shrinkage. But as the pay quantities are otherwise determined, accuracy of a shrinkage allowance has not been deemed important.

An entirely different situation has arisen in the valuation work. The fills ,as well as the cuts, must be measured, and the problem presented is what should be added to the measured embankment quantities as developed by the Bureau of Valuation to be equivalent to the yardage required to construct the embankment, where the borrow pits cannot be located. The studies submitted amply and clearly show that shrinkage always does exist, doubtless varying in quantity, and the committee suggests that as a practical matter and in the interest of economical and prompt prosecution of the work of valuation an average allowance of not less than 10 per cent is fully warranted.

It was suggested to some of the railways, therefore, that they should compare the figures developed by the field measurements of the Bureau of Valuation with the actual figures from their records. Such a study was made covering nearly 40,000,000 cu. yd. and the average difference in original and present quantities thus developed was 14.4 per cent. As most of the measurements in this particular study were made several years after the construction of the fills the committee considers that 14.4 per cent is a more correct allowance than the 9.1 per cent allowance now made by the Bureau of Valuation. Table III gives a portion of this tabulated comparison, showing the relatively low figures obtained by the rule of the Bureau of Valuation. The report closes with the following statement:

"The committee suggests that judgment and care should be exercised in determining the percentage of swell and shrinkage to be applied in different cases, giving due consideration to the varying character of the materials encountered, and that as an approximate method (except in some special cases) a swell of 30 per cent for rock should not be exceeded, even in comparatively new banks, nor should the shrinkage allowed for earth be less than 10 per cent."

TABLE III. COMPARISON RAILWAY RECORDS OF EARTHWORK WITH FIELD MEASUREMENTS MADE BY INTERSTATE COMMERCE COMMISSION

Railway	State	Fill Built	Miles of Fill	Cubic Yds from Railway Records	Cu. Yds. Meas. I. C. C.	Difference Per Cent of Col. 6
O. W. Ry. & N.	Wash.	1886	2.7	23,160	20,073	13.03
L. A. & S. L.	Utah	1902-03	116.0	3,861,567	3,333,237	15.85
Gt. Nor.	No. Dak.	1905	13.0	137,418	124,991	9.94
Gt. Nor.	No. Dak.	1904	5.0	80,871	70,634	14.49
Gt. Nor.	No. Dak.	1904	0.34	5,571	4,692	18.73
Gt. Nor.	No. Dak.	1906	42.0	578,942	537,662	7.68
Gt. Nor.	So. Dak.	1888	14.5	89,527	81,527	9.81
No. Pac.	No. Dak.	1903-05	40.0	458,766	407,481	12.59
No. Pac.	No. Dak.	1909-10	91.0	1,824,058	1,644,760	10.90
C. & N. W.	Minn.	1899	195.0	2,856,724	2,412,624	18.41
C. & N. W.	So. Dak.	1882	13.0	170,348	158,097	7.75
C. & N. W.	Iowa	1910	29.0	875,255	767,588	14.03
C. & N. W.	Wis.	1900	166.0	1,093,172	1,028,752	6.26
C. & N. W.	Wis.	1891	40.0	550,630	515,187	6.88
C. & N. W.	Ill.	1912	86.5	3,052,397	2,850,280	7.09
Soo Line	Mont. & Dak.			8,438,134	7,813,704	7.97
Ill. Cent.	Ill.	1907-08	1.13	358,408	311,977	14.88
Ill. Cent.	Ill.	1903	17.0	811,342	681,958	18.97
Ill. Cent.	Iowa	1898-1900	131.0	5,131,184	4,101,532	25.10
Ill. Cent.	Miss.	1907-08	27.5	407,072	287,304	41.69
Ill. Cent.	La.	1907-08	65.0	765,814	542,571	41.15
Wabash	Ohio	1902	11.0	153,761	119,007	29.20
Penna.	Md.	1870+	48.7	1,266,491	886,682	42.83

NOTE—The percentages in the last column may be modified by allowances based on later information in regard to subsidence.

Directory of City Health Officers

A directory of health officers in cities and counties having an estimated population of more than 10,000 is given in U. S. Public Health Reports for July 2, 1920. An asterisk denotes "full-time" officers. Such an officer is defined as "one who does not engage in the practice of medicine or in any other business, but devotes all his time to official business."

Check of Immigration Requires Labor Conservation

ON returning from a survey of industrial conditions in Europe, Frances A. Kellor, vice-chairman of the Inter-Racial Council, New York City, proposed the following statement regarding the need for labor conservation in America due to the check of immigration:

The time has passed when the American employer could count upon an unlimited supply of labor from abroad. Emigration from the countries of Europe will be strictly regulated by the governments in the near future, and is already being directed in some of the Old World nations, which have begun to realize the value of their workers.

This is the case in Italy, for instance, which has supplied us with such vast numbers of unskilled and semi-skilled laborers. The French Government has offered Italy six tons of coal per month for each Italian miner induced to go to France, and the Commissioner of Emigration of Italy is advising his people to emigrate to France. It is asserted that opportunities are better there than in America, both for steady work and high wages. Other countries are making efforts to keep their citizens at home. Greece is offering inducements of farms to the people, having passed an act by which large land owners may retain only one-third of their estates, while surrendering two-thirds to the peasants. If this offer should not be sufficiently persuasive, emigration from Greece may be prohibited at any time by law. Conditions in that country are being studied at present to determine what action may be necessary to prevent an undue exodus of the population. The extension of Greek territory is a powerful reason for keeping these people in their own country. Similar conditions are found in Finland, where areas have been set aside for settlement, and farm implements and supplies are offered to small cultivators on liberal terms.

Attitude of Foreign Governments

These instances show the attitude of foreign governments toward their nationals. Instead of permitting their men and women to leave at will and select their own destinations, as in our port, emigration will be curtailed, by many governments, to the extent deemed expedient for their own interests. Instead of the emigrant selecting his own future home, the governments will advise him where to go, and in some cases will retain him as a citizen, with voting rights, even while living abroad. At present the Lithuanians in America have three deputies to represent them at the next meeting of the Constituent Assembly of Lithuania, while Italy has under consideration a plan to give its nationals throughout the world elective representation in its home government.

This means that the immigrants who do come here will have less tendency to make America their permanent home and become citizens, hence we will have to make greater efforts to assimilate them than we have done in the past. It indicates a policy opposed to the best interests of America, and which should be opposed by our people before it becomes an accomplished fact.

Some of the foreign nations are planning to do the things which America should have done long ago; to protect immigrants from fraud, to establish official information bureaus, to take care of their savings through branch banks and generally to look after their welfare. International agreements are being made between Old World countries regarding immigration. Diplomats of Hungary, Poland, Greece, Italy, France, Lithuania, Spain, Portugal and the Balkan countries have taken the lead in such conferences, but the United States, which has so much at stake in the matter, has shown indifference. If our supply of coal, iron, oil or cotton were threatened, the whole nation would be aroused, but with the imminent curtailment of our labor supply, even at this time of acute labor shortage, the Government and the business men who should be interested are remaining quite apathetic.

The new era of world-wide business requires an international view of conditions if American interests are to be adequately cared for. To help meet this need, the Inter-racial Council has planned a series of bulletins reflecting the world movements and endeavoring to interpret them.

These are no longer mere academic questions, but matters of direct concern to the American business man. When the manifesto of a leader in Russia can react with greater force upon the workers than the words of the plant executives, or when a stream of literature in foreign languages can counteract utterances in the American press or in plant organs, it is essential to the self-interest of the American business man that he should know about these things and act with information on the facts.

Meanwhile it is to the interest of every industry to conserve the present inadequate labor supply and make the best use of it. The tendency of the foreign-born workers to return to their old homes should be checked by every legitimate means. The most powerful inducement to them to remain is of course just and humane treatment, with no discrimination in wages, housing, living and working conditions between them and the native born. Efforts should be made to establish closer relations with the foreign born workers. If they have legitimate causes for discontent, the grievances should be understood and removed. The same spirit of co-operation that is being secured through enlightened employers and their English-speaking workers should be developed into relation to the foreign born laborers.

This is not "coddling," not philanthropy, but labor conservation. As in the early days of America we were wasteful of our resources, coal and oil, natural gas and timber, until we saw the results of extravagance, so at present we are as wasteful of our man-power as if the supply were inexhaustible.

We should not be deceived by the temporary increase in immigration. The figures that indicate a large number of arrivals at Ellis Island fail to show the fact that the proportion of women, children, professional and clerical workers is so great as to afford little relief to our labor shortage. Of the manual laborers coming in, a large percentage are men who went abroad to fight and are now returning to their old jobs. Of new workers, to do the essential work of America, there is an exceedingly small percentage, while recent correspondence from all parts of the United States indicates serious shortage of labor.

The course of action for the employer is therefore, first, to conserve labor as carefully as he conserves his raw material; second, to regard immigration problems with the same interest that he gives to international commerce, realizing that America is no longer isolated and that what happens in the Old World today will be reflected in his own business tomorrow.

An international conference on immigration is planned for 1921, in which the United States should play a leading part. Business men who are interested may obtain further details through The Inter-racial Council, Woolworth Building, New York City.

Use of Peat on Swedish Railways

Interesting trials to test the possibilities of peat as fuel for locomotives have been in progress for some months on several railways in Sweden. The reports so far show favorable results. One privately owned railroad in southern Sweden, 256 mi. in length, has found peat so practical for steam purposes that the management believes the road can dispense entirely with coal. The State Railways have likewise been testing peat for steam purposes, with good results, and have on a limited scale adopted it for fuel. For some years the State Railways have been operating a factory for the production of peat powder, which is said to make an excellent fuel. In Sweden, where there are 10,000,000 acres of peat bogs, with an average depth of 6.6 ft., the substitution of peat for coal would add enormously to the national wealth. Every acre of peat bog yields nearly 1,000 tons of prepared peat.—*Commerce Reports.*

Notes from Foreign Fields

BRUSSELS—THE CITY BEAUTIFUL

BY
E. J. Mehren
EDITOR ENGINEERING NEWS-RECORD

AFTER a voyge of more than a week one expects to find on this side of the Atlantic a different country. So England is. But after a month in England one is astonished at the marked difference one finds after the three-hour ride across the Channel—from Dover to Ostend.

We leave a land of brick and of narrow streets, cities of dun hue, and arrive in a community of broad avenues, sparkling with the brightness of the white and cream-colored houses, houses which give the impression of being built of stone even when the walls are of stucco. After a week in Brussels one still walks along enchanted by the delightful vistas afforded by its city planners. In England one's thoughts are occupied with the utilitarian—the pavements, the transportation facilities, the traffic. Here one revels in those features which go to make a city beautiful.

Yet Brussels is but a foretaste of Paris. Here there are two rings of boulevards, the inner one around the older part of the city. From these run broad radial avenues in every direction. Rectangular planning is conspicuous by its absence. Many of the avenues are tree-planted. The boulevards have grass plots, generally with four lines of trees, a central driveway for passenger vehicles and two side carriageways for the commercial vehicles and the street railways. Street widths naturally vary with the character and location of the street. Some new streets are as narrow as 14 m. between property (fence) lines, with carriageways of 7 m. On the other hand, some new residence streets may be as much as 25 m. wide between property lines, with 12-m. carriageways. Main arterial ways are wider, while the boulevards are as much as 77 m. between property lines. That is the width in large part of the inner ring of boulevards.

This inner ring has a maximum diameter of only about 2 km. (1.2 miles) and in the course of an ordinary business day one is constantly crossing it. The effect is most favorable.

CLOSE-JOINTED SANDSTONE BLOCK PAVEMENT

STATE PLANTED FOREST NEAR BRUSSELS

Nor are the broad avenues and the boulevards the only features that impress the visitor. Squares are common, not merely the stone-paved spaces for the accommodation of traffic at important cross-routes, but the park squares. They, too, elbow close to the business quarter. In them, tucked away in nooks of shrubbery, are beautiful statues, not merely of the commemorative sort, but of a subject befitting the location. Of commemorative statuary there is a great deal—as is the case in England also—but it stands rather in the paved squares where the multitudes circulate and the great can receive the attention their achievements merit.

THREE TYPES OF CART SEEN IN BELGIAN CITIES

Paving—From the paving standpoint Brussels is a city of stone. Such pavements are found even in the residential districts, though for such neighborhoods tar-macadam and asphalt are coming into use. For the heaviest traffic porphyry is used; for lighter traffic and on grades, a sandstone, called *grès* is favored. Most of the stone paving is on old macadam foundation, using a 3-in. cushion of sand. Sand is used exclusively for jointing. The blocks vary in size, but the most common is 10 cm. wide, 15 cm. long and either 12 or 14 cm. deep (4 x 6 in. by 4.8 to 5.6 in. deep). Where a concrete foundation has been used the thickness has been only 10 cm. (4 in.) but the recent specifications call for 15 cm. (6 in.). The proportions are 1 : 2½ : 5.

The Brussels experience, however, is of relatively small value for us, because the traffic is light. There are but few motor-trucks.

One feature of their stone-block experience should be emphasized—the success they have had with sandstone. It reminds one of the fine medina sandstone one formerly saw in Cleveland. *Grès*, the sandstone used here, wears very evenly. For grades it has a grittiness that the porphyry lacks. Its life, naturally, is shorter than that of volcanic rock. The life of porphyry under the traffic of the business center is from 25 to 30 years; on residence streets, from 40 to 50 years. Good maintenance is, of course, necessary to get these terms of service.

Before the war these pavements on old macadam foundations cost from about $2.20 to $2.75 per square yard. The cost now is from three to four times as much.

Brussels, June 9.

BELGIUM'S RECOVERY—YPRES

IN BELGIUM one realizes that he is at the seat of war. In going from London to Brussels one first sees war destruction at Ostend. The "Vindictive" still lies in the harbor entrance, though its removal is under way; the dock buildings are being reconstructed, while houses along the shore are damaged. One quickly leaves these

COVERED DRAIN FOR BROOK AT YPRES TORN BY SHELLS

evidence of destruction, but other reminders of the war are always at hand. Along the railroads German rolling stock is to be seen; minor coins of a zinc composition largely replace the nickel coinage, while paper one-franc notes are the most common medium of exchange. These 2 x 3½-in. bits of paper, issued by two of the leading banks, one of them the Banque Nationale, cost Americans about 8 cents each, against a normal value of about 19 cents.

Costs have gone up 350 per cent and therefore one pays what sound like abnormal prices. A luncheon bill for four totaling 90 or 100 francs is at first a great shock, but the use of the 8-cent factor restores one's composure.

In talking to engineers and business men here one catches a tone of confidence that is very gratifying. We remember the difficulty of getting the Belgian people back to work. Even now production per man is not up to pre-war levels, but it has improved so much since the middle of last year that Belgians are quite optimistic. The rate of increase of the unfavorable trade balance is decreasing every month. Unemployment has practically disappeared.

Labor costs have naturally gone up. Men who received from 4 to 6 francs per day before the war receive 20 to 25 francs now. Their efficiency, one qualified business man stated, had risen from exceedingly low figures last year to probably 80 per cent now, based on pre-war production. Remembering that the Belgian has alwa[ys] been a faithful and hard worker, he is today more nea[rly] earning his wages than the American or the Bri[tish] worker.

With these high labor costs, contractors and manufacturers are looking into the possibility of using labor-saving machinery. Among the larger contractors th[e] performance of American construction machinery [is] well understood, but just now there is practically no market for it, principally because the rate of exchange makes its cost prohibitive. Moreover, the Belgian contractor, noting the increase in efficiency during the last year and hoping that the cost of living will soon begin to fall, is inclined to defer buying, believing that there is a possibility of having again cheap construction labor in Belgium.

Before the war the Germans dominated the market for what equipment, such as steam shovels, cranes, hoists, etc., was sold. The prejudice against the Germans is still strong and with the readjustment of exchange there should be a field here for the American builder of construction plant. The Belgian worker has no prejudice against the use of machinery, so that one of the difficulties encountered in England at least, is not here present.

YPRES

While the industries are busy, the restoration of the destroyed region in the neighborhood of Ypres is not proceeding rapidly. In going to Ypres from Brussels one sees an astonishing contrast—between a marvelously farmed countryside and chaos. Until one reaches Coutrai one would not know that the land had for four years been in the hands of an invader, but in the trainshed there no glass remains, while bullet and shell-splinter marks show that here was military action. Gradually other signs of war appear, here a house in ruins, there a huge heap of jetsam of war—piles of barbed wire, some scrapped concrete mixers, a road roller or two. Near Menin the zone of severe destruction is reached, but even there the fields are again under cultivation. In the town, much damaged, little houses with concrete foundations and semicircular roofs of corrugated iron fill some of the gaps.

At Comines the fullness of destruction is reached. Barbed-wire entanglements in process of removal, trenches, shell holes are everywhere. In an occasional dugout a Belgian has re-established his home.

Round about as far as the eye can reach, "No Man's Land"—and it looks it; the ground broken into a hopeless series of pits and hollows; the forests reduced to dead sticks; no sign of houses or land lives, save when at great intervals the red roof of a new house serves only to emphasize the desolation.

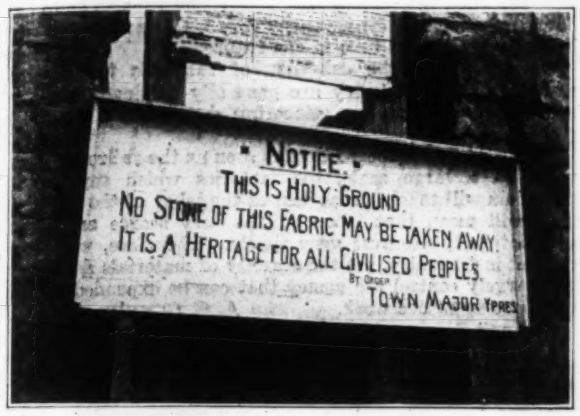
Ruin—the land swept as if by an avenging hand. I can think of nothing to liken it to but our American deserts. Only those dead silences can convey the impression of lonesomeness, of desertion. There, though, we have sand and sage and greasewood. Here it is green, the pock-marked earth grown up with burdock and chickweed and thistles. There is no relief, no emphasis, save for that of the gas-killed trees.

In Ypres there is nothing but ruin. Not a single house remains intact. Most of them are heaps of brick and mortar. The imposing buildings—the cathedral and the Cloth Hall—still fling high their shell-torn walls, while to emphasize what happened here the council of Ypres has put up at intervals this sign:

The Burgomaster and the City Council of Ypres urge you to remember that the ground on which you walk is hallowed by the sacrifice of 250,000 British officers and men, who were killed or wounded in four terrible years of battle endured in the salient of Ypres, and whose heroism Belgium can never forget.

Another sign found in different parts of the town is shown in one of the photos.

The city, so the Belgian government has decided, will not be rebuilt but will be kept as a national memorial.


NOTICE.
THIS IS HOLY GROUND.
NO STONE OF THIS FABRIC MAY BE TAKEN AWAY.
IT IS A HERITAGE FOR ALL CIVILISED PEOPLES.
BY ORDER
TOWN MAJOR YPRES

A SIGN BOARD AT YPRES

Round about new houses are springing up and the people are busy cleaning up the wreckage.

Except in Ypres and a few other towns, however, progress has been slow. The barbed wire has largely disappeared, but the trenches and shell holes are still there. Occasionally a little patch of land has been newly plowed. Effort seems to have been concentrated on restoring the village life and the farms in the less severely damaged area. Soon probably the other areas will be taken in hand.

For the remainder of this year, however, one can get at Ypres some conception of No Man's Land. It is not a pleasant place—nor a place for the merely curious. It is for those who want to appreciate to the full the horrors—and the accompanying heroism—of war.

Brussels, June 11, 1920.

Shipping Board to Sell Steel Vessels

MINIMUM selling prices for different types of Shipping Board vessels have been fixed by the board as follows: Lake and Submarine Boat Corp. types, $160; Hog Island, Skinner & Eddy, and all types over 10,000 tons, except combination cargo and passenger vessels, oil tankers and refrigerator vessels, $175. These prices are per ton deadweight rating, and for ships equipped to burn coal. Where they are fitted for oil burning the prices are $10 per ton higher. Part payment terms are offered by the board, under which 10 per cent of the purchase price must be paid in cash on delivery of the vessel and the remainder in installments covering a period of 12 years, deferred payments carrying interest at 5 per cent. Control of a certain part of the earnings of the vessel is maintained by the board until 50 per cent of the purchase price has been paid. These selling offers are made under the terms of the 1920 Merchant Marine Act.

Asphalt Maintenance Costs in Columbus

FROM its local representatives at Columbus, Ohio, the Barber Asphalt Paving Co. has received a report on maintenance costs of asphalt pavement in that city, from which the following data are taken:

Columbus has 1,320,628 sq.yd. of asphalt pavement, of which 1,002,990 sq.yd. are laid with native lake asphalt. On thirteen streets, comprising a yardage of 101,502, the average life of the asphalt pavement has been 28.77 years. For eleven of the streets the average cost of maintenance per square yard per year has been 3.3c. Figures for the other two pavements have not been kept.

Bryden Road from Parsons Avenue to Twenty-second Street, an area of 12,573 sq.yd., was laid in 1888, or 32 years ago. The cost for maintenance per square yard per year has been 2.1c. The cost of maintaining King Avenue from High Street to Neil Avenue laid 30 years ago and covering 8,683 sq.yd. has been 2.2c. figured on the same basis; 14,612 sq.yd. on Franklin Avenue from Parsons Avenue to Wilson Avenue, also laid in 1890, have required 3.2c. per sq. yd. per year. Washington Avenue, with 10,646 sq.yd. from Broad to Buckingham Street, paved in 1891, has proved slightly more expensive to maintain, the figure being 4.9c. This, however, is the highest figure in the list of the thirteen streets more than 23 yr. old.

The following table gives the maintenance figures for the old streets:

Streets	Year Laid	Square Yards	Maintenance Cost per Square Yard per Year
Champion Ave., Broad St. to Mt. Vernon Ave.	1889	8,448	$0 036
Cleveland Ave., Broad St. to Long St.	1896	3,820	0 023
18th Street, Bryden Rd. to Main St.	1892	2,985	0 032
Hamilton Ave., Broad St. to Long St.	1897	4,377	0 029
High St., Poplar Ave. to Fifth Ave.	1895	13,700	
Ohio Ave., Broad St. to Main St.	1889	9,878	0 044
Parsons Ave., Broad St. to Main St.	1891	7,248	0 039
17th Street, Main St. to Bryden Road	1890	3,181	0 039
State Street, High St. to Pearl St.	1888	1,351	

All of these streets were paved with Trinidad Lake asphalt. Of the total yardage of asphalt streets in Columbus, 999,782 sq.yd. or approximately 76 per cent, were laid with Trinidad Lake asphalt. Bermudez Lake asphalt was used for 3,208 sq.yd.

The foregoing figures were submitted to Henry Maetzel, chief engineer of the division of engineering and construction of the Department of Public Service, who makes the following comment:

"The figures are correct as shown by our records. However, the following explanation will be in order.

"Prior to 1907 our maintenance work was done by contract. Since then the city has operated an asphalt repair plant and made all repairs. Figures of cost given do not include interest on outlay for asphalt plant or any depreciation. This would increase the cost perhaps 10 per cent. The cost is averaged over the entire life of the pavement, though very little was spent during the first ten years."

Erie R.R. Uses the Chicago River

Operation of two local freight yards on the Chicago River at Erie St. and Webster Ave. has been commenced by the Erie R.R., cars being transferred on barges between these yards and the main Chicago freight yard at 18th St. This is a resumption of local freight service which was abandoned during the war.

LETTERS TO THE EDITOR

Effect of Increased Rates on Railroad Construction

[*The following letters are in reply to inquiry from the "Engineering News-Record" in regard to the probable effect of the recent increase in railroad rates on railroad construction.—Editor*]

Sir—Replying to your recent letter regarding effect on railroad construction due to the increase in railroad rates. I will answer your questions in order as follows:

1.—The railroads will not be able to launch programs of construction until it is possible to secure the necessary funds with which to make improvements which is dependent upon the restoration of the credit of the railroads.

2.—It is likely that it will be some time next year before the additions and betterments program can be undertaken on a large scale.

3.—The transportation of materials is now affecting the construction the same as it is with other industries.

4.—(a) The first consideration for expansion of facilities is more locomotives and cars, (b) engine terminals and shops to take care of the equipment, (c) yards and terminals to provide facilities for the more expeditious handling of traffic, (d) double tracking to expedite the movement between terminals.

This is about the order in which the transportation facilities of the country today require expansion.

5.—It is likely there will be an expansion in the engineering departments and personnel to meet the new situation. This is due to requirement that the railroads of the country must be honestly, efficiently and economically managed and this can best be done through a thorough reorganization of the departments.

6.—The railroad facilities of the country are today from three to five years behind in their normal development and it will require that length of time to put the transportation business in proper condition to handle the traffic offered.

L. C. FRITCH,
Chicago. Vice-President, Chicago, Rock Island and Pacific Railway Co.

Sir—Now that substantial increases in rates have been granted the railroads, it is expected that the surplus earnings will enable the roads to make large expenditures in improvements. This is a matter of great interest to the public in general; for, when railroads spend large sums of money, general prosperity results therefrom.

Just at present the railroads are waiting to find out what the advance in rates and wages will mean in earnings before deciding what should be done. It is natural to suppose, therefore, that if the results of these earnings are what may be expected, work on a large scale will follow.

At the present time the railroads are hampered by the want of equipment, and this is largely due to need of repairs, to bad order cars and to scarcity of engines, and while this continues the lack of transportation facilities will naturally hamper the progress of the work. So before much can be done, it will be necessary greatly to increase the number of cars by building new ones and repairing those in bad order, and the number of engines must be increased materially.

It must be remembered that just previous to the war and during Government control it was almost impossible to get materials and labor for repairs to keep the tracks up to the standard, and the first work to be done would be largely that of renewal of ballast, ties, and rails, but as there is still a scarcity of labor and materials for carrying on work, progress in these lines of work will be slow.

The season of the year is so far advanced that no immediate construction will be done by the railroads, and the outlook has been so gloomy that no important construction programs have been made. In all probability extensive plans for additions and betterments will be made during the winter months so that work may be started the Spring.

Because of the difficulty of getting materials, a great deal will not be accomplished during the coming year to relieve the shortage of transportation facilities of the railroads, and until steel mills are able to turn out a greater tonnage than at present it will not be possible for the railroads to accomplish much.

From this it is plain it will be one to two years before the railroads will be able to start on any extensive plans for necessary enlargements to keep up with the times. Engine terminals, double-tracking and yards will undoubtedly receive first attention in order to shorten division runs so as to cut down overtime, and consequently very little line revision will be made until some time in the future.

On account of the valuation of railroads the surplus engineers of the country are generally employed, so that no large expansion in engineering departments can take place.

It must be remembered that as soon as the railroads start work on a large scale, the factories which supply the materials will take a great deal of the labor of the country. This will mean that labor will be very scarce and work will naturally progress very slowly. Therefore, while the outlook is favorable, yet the scarcity of materials and labor will largely control the money that can be expended by the railroads in future work.

A. O. CUNNINGHAM,
St. Louis. Chief Engineer, Wabash Railway Co.

Engineers in Railroad Wage Award

Sir—I have noted the letter published in your issue of Aug. 5, p. 279, by W. J. Sykes in which it is intimated that the engineering societies were largely responsible for the lack of technical recognition in the recent railroad wage award. It appears to many of us that discrimination was used against the engineering profession by the board and that the technical societies have been equally guilty in not protesting *en masse*.

Judge Barton, chairman of the award board, was quoted on the subject as follows: "Civil engineers as such had no submission presented for them and hence no question as to them decided. In all the argumentative debate of the board in executive session, civil engineers (broadly speaking, professional engineers) were not considered because they had not been properly before the board in hearing." Judge Barton further made plain the proper procedure by explaining that the board cannot and will not entertain or receive for hearing any case until it can be shown and evidence produced to substantiate that a reasonable amount of effort has been expended by the professional engineers to seek or hold a conference with the managment of the carrier in an attempt to settle any dispute involving salaries.

This is a perfect argument for unionism. Yet the technical societies have always frowned down on any such suggestions. If we are not to unionize, have we not the right to expect these societies to protect the individual members from financial losses in consequence of such a decision? Judge Barton and the only one of the "57 societies" making any attempts along this line except the individuals or at least the local groups in the different railroad offices to make these efforts and forward proof of same. Was proof offered that each individual member or each individual local of the different unions made such attempts? If the unions were permitted to make demands through national organizations and thus be considered as complying with the law, why would not a similar demand by a national engineering society have equal weight, and if not, why did not the national society protect against such discrimination?

Probably there will never be another opportunity to benefit the profession as a whole in such a widespread manner. The trade unions have demonstrated beyond question that to benefit one benefits all. This is not a question which concerns railroad engineers only or even primarily. It is manifestly unfair to expect unorganized engineers to comply with the same legal technicalities as unions hav-

in paid officials unless the paid officials of the various technical societies deign to represent their members. Conditions are different from those of even five years ago, and in answer to Mr. Sykes' last question, it is most certainly not improper to expect these paid officials of the societies to keep abreast of the times, to quit dreaming abstract problems long enough to recognize an opportunity to elevate the profession as a whole, and above all, to quit passing the buck to the individual engineers who have no paid representatives but them to look to in times of adverse discrimination.

W. H. HOBBS.

Danville, Ill.

Sir—Why were the technical engineers left out of the railroad wage award?

Primarily because the wage board was a political machine element quickly thrown together as a stop gap to fend off a strike which would have taken place.

The board did not consider the technical engineer because the "57 varieties" of engineering societies mentioned by Mr. Sykes are not affiliated with any of the labor bodies who get their demands because they are enabled to enforce them.

The wage board visualized the engineers in terms of transits, levels, drafting boards and blueprints just the same as the public does.

The employer of the engineer regards him as a necessary evil; hires him under protest; charges him up to profit and loss and fires him with glee.

The engineering societies have their heads in the clouds, engaged in dry and dusty discussions—abstruse discussions of ethics, problems, etc.—and hold their professional standing so close to their eyes they can't see the rest of the big world: To the total neglect of the actual wants and necessities of themselves as a body. And money is everything today with a fifty-cent dollar.

One notable exception is the American Association of Engineers which has done more for the engineering profession, or trade, or occupation in five years than the rest put together in fifty years. If the engineers get anything out of this wage award it will be through their efforts as a body and not through individual wails.

ROBT. H. BALDWIN,
Constructing Engineer,
Chicago Northwestern Railway Co.

Chicago.

Shear in Reinforced Concrete; Mr. Godfrey Issues a Challenge

Sir—A new Joint Committee on Concrete and Reinforced Concrete is at work preparing standards of design. Presumably it will include in those standards provisions for shear in reinforced-concrete beams, a subject on which the writer has been in controversy with the accepted authorities for many years. The progress in this detail of design, however, has been so slow and the dangers of present accepted standards so great that I would like once more to call attention to the inadequacies and inaccuracies of present practice in the hope of provoking a defense of that practice which will hold water.

The writer will admit that some little progress has been made in shear provisions. Quite recently the American Concrete Institute adopted as standard the Building Regulations for the Use of Reinforced-Concrete. In the preliminary draft of that report it was provided that tension rods in beams bent up at an angle to provide against shear would have to make an angle of 60 deg. or less with the vertical. The writer opposed this provision in a discussion sent to the committee in advance and the final report changed the angle to be 0 to 90 deg., thus permitting the flat slope anchored diagonal rods advocated by the writer. In these same standards anchorage of the main steel rods into the supports is recommended, but only in special cases. These cases are where the shear on the concrete is so excessively high that it is past the initial point of web failure. These standards allow 12 per cent of the ultimate compressive strength in shears on a beam, if the main rods reach into the supports for anchorage. With 2,500-lb.

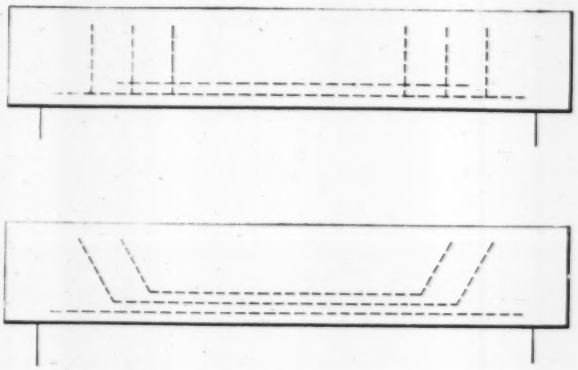


FIG. 1. STANDARD REINFORCED-CONCRETE BEAMS

concrete this would be 300 lb. per square inch. This excessive confidence in the shearing strength of reinforced-concrete beams is apparently based on tests of some extraordinary beams of I-shape where the initial point of failure of the web was between 200 and 300 lb. per square inch. These regulations allow an optional web reinforcement in the shape of bent-up and anchored main reinforcing rods as recommended by the writer.

How many engineers know that these same standards of the American Concrete Institute, in any beam or girder where the shear is not greater than 6 per cent of the ultimate compressive strength, do not require that any steel whatever cross the plane of the face of the wall or column supporting that beam or girder. Nor does the present Joint Committee report require any such tying steel, except in a vague and ambiguous reference on the subject of

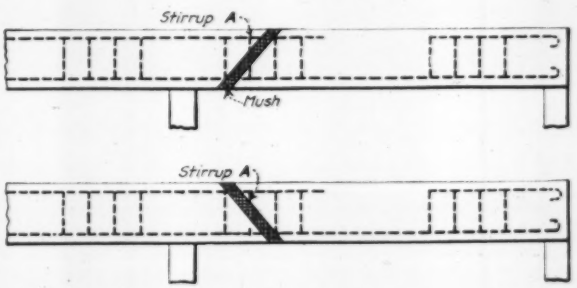


FIG. 2. WHAT STRESS IS IN STIRRUP "A"

shrinkage to connecting floor and wall members in an articulated structure. This is decidedly worthy of study. Possibly no seasoned designer would take advantage of this, but regulations are not made for seasoned designers. The beams shown in Fig. 1 are standard under the ruling of the American Concrete Institute and of the Joint Committee on Concrete and Reinforced Concrete. Stirrups are required in the beam—to hold it together for fear that it might break in two if it should fall away from the supports; but holding a beam to the support appears to be no concern of the writers of standards. Some designers are now making some of the main reinforcing rods shorter than the span of the beam. It is interesting to observe how designers discover the loopholes that allow them to save a few pounds of steel.

It seems to the writer that the basis on which rests this utter lack of provision for uniting the beam and the support by reinforcement is the action of most beams in laboratory tests. The writers of standards are blinded by the behavior of test beams. Because of the lack of shrinkage tension in the isolated specimen and because of the arch action on immovable supports, precluding tension near the supports, and because the rods do extend over the supports in test pieces, it is scarcely possible for a laboratory test beam to break close to the supports. No large tension can possibly be developed there. The shear or diagonal

tension breaks develop a short distance from the supports in these artificial tests, which are made as unlike a building as they can be. Is that why, in standards, stirrups are not required closer to the supports than a half a beam depth or so away from them? Let us forget the laboratory tests and look at wrecks of concrete buildings. When buildings fail, beams and girders break close to the supports, and stirrups or short shear members are frequently of no more value than if they were painted on the side of the beam. Shrinkage of the entire building produces a tension and standard designs make no allowance for this whatever.

It seems to the writer that there is a simple demonstration of the claim that he has often made that there is no force in a whole beam tending to elongate a stirrup. Given two beams, as per the sketch in Fig. 2, identically designed; assume a layer of mush in the first as indicated, stirrup A will be in tension; assume a layer of mush in the second, stirrup A will be in compression. This surely does not need other proof than engineering common sense. Furthermore, stirrup A will take *all* of the shear of the beam and *not* a portion, depending on the spacing of the stirrups. It will take the shear apportioned in standards to the concrete as well as that apportioned to the stirrups. It is only in a crippled web that a stirrup can take any stress, and it depends somewhat on how the mush may be laid which way that stress is going to jump.

The writer has frequently endeavored to induce, persuade, banter, challenge, coax, shame, and provoke some one to produce an analysis of the stress in the stirrup or short shear member. That analysis is yet to come. A new Joint Committee is at work. Here is something for them to consider. Reinforced-concrete standards of design will not be on a sound basis until one of three things occus: (1) The writer's statements are shown to be false; (2) his arguments are shown to be fallacious; (3) the standards are revised to agree with those statements and arguments. This condition calls for something more than silence on the part of the men responsible for the present standards, and something sounder than ridicule of one who criticises them.

EDWARD GODFREY.

Pittsburgh, Pa.

Marine Railway at Astoria, Oregon, Not Yet Completed

Sir—In an article appearing in *Engineering News-Record* of June 10, p. 1156, entitled, "Marine Railway for 5,000-Ton Ships at Astoria, Oregon," the impression was given that the marine railway which was under construction was a completed railway and was in operation. In order that the shipping interests and others may be correctly informed, I believe it would be advisable to state that the marine railway has not as yet been completed, and further, that construction work has been suspended for some time.

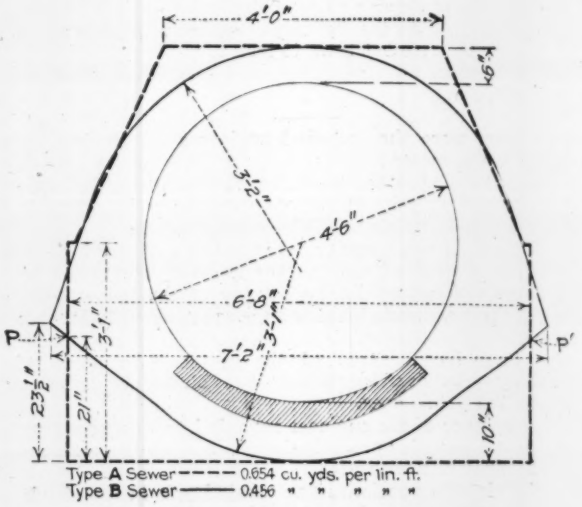
Jasper, Wyo. C. O. CRISMAN.

Composite Design for Sewer Section

Sir—The article by John P. Wentworth in your issue of July 22, p. 148, on "Sewer Cost Lowered by Increasing Concrete Yardage in Section," emphasizes a real vital point in economical concrete design in calling attention to the need of reducing labor and form costs even though quantity of concrete be thereby increased.

The enclosed diagram shows Mr. Wentworth's Type A and Type B sewer cross-section superimposed, and brings out clearly the advantages of Type A in form work and labor, as against the advantages of Type B in concrete. It rather suggests, however, a composite design, utilizing the advantages of Type A above points *P* and *P'*, while using Type B below, in order to eliminate the excess concrete in the lower corners of Type A. This design would call for 0.500 cu.yd. of concrete per linear foot of sewer, nearly 25 per cent less than Type A, and but 10 per cent more than Type B.

Comparing Type A and the composite design from the viewpoint of the contractor, the extra cost of shaping the bottom of the trench should be balanced by the saving in material to be excavated. Form work would be the same. Overhead charges would be unchanged, unless the saving in concrete permitted speeding the work up somewhat. This would leave a net saving equal to the cost of materials and



COMPOSITE SEWER SECTION PROPOSED

Design utilizes Type B below points P and P¹ and Type A above. Composite design calls for 0.500 cu.yd. of concrete per linear foot of sewer.

labor to mix and place 0.15 cu.yd. of concrete per linear foot of sewer, amounting to possibly a dollar and a half.

I would be interested to hear from Mr. Wentworth whether this type was suggested, and whether any practical difficulties were brought up against it.

M. F. SAYER,

Assistant Professor of Applied Mechanics, Union College.

Schenectady, N. Y.

[Copy of Prof. Sayer's letter was submitted to Mr. Wentworth, whose reply follows.—EDITOR.]

Sir—Several types of sewers, in addition to Types A and B, were considered. A cross-section very similar to the composite cross-section suggested by Professor Sayer was studied, but it was not thought advisable to adopt it. With such a section the contractor would be obliged to use greater care in excavation, in placing the lower inside forms and in pouring and spading the concrete in the lower portion of the sewer to prevent foreign material from rolling into the bottom of the trench under the forms. In my opinion, the extra cost of shaping the bottom of the trench would exceed the saving in material excavated. The material at the bottom of the trench is gravel and sand (some of the sand is being used for concrete) which can be excavated cheaply, but which could not be as easily shaped for a Type B or composite type as could other materials.

Last year a small sewer designed with a cross-section similar to Type B was constructed under the writer's direction. The contractor, rather than construct such a section, excavated deeper at the sides of the trench and used more concrete, although he did not quite go to the limit shown in Type A. For this extra excavation and concrete he received no compensation. This contractor was a very capable man and had done a large amount of sewer work. His method of doing the work showed that he believed a heavy section was more economical to construct than a light one.

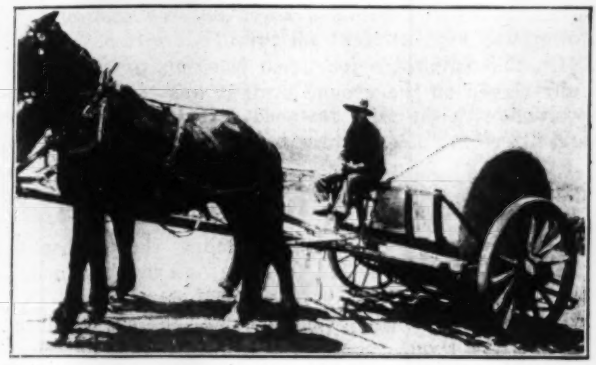
JOHN P. WENTWORTH,

Boston. Metcalf & Eddy, Consulting Engineers.

HINTS FOR THE CONTRACTOR

Improvised Cart Hauls 3,200-Lb. Sections of Precast Concrete Pipe

TWO-WHEEL carts with cradle bodies hung low on gooseneck axles are being used to advantage in hauling precast concrete pipe for the Parley's high line conduit being built to extend the water supply of Salt Lake City. The pipe, produced at a central casting plant, are 4 ft. long and 48-in. in diameter and weigh approximately 3,200 lb. The carts, as indicated by the illustration, are simple; using old dump cart wheels, they cost not to exceed $50 apiece. The pipe line, 17,100 ft



CRADLE BODY TAKES ONE 4 x 4-FT. PIPE

long, is being laid at the rate of 275 to 300 ft. in an 8-hr. day, and six carts and two low trucks are used for hauling, the average haul per day being 14 to 17 mi. for each team. Two men and the teamster, using skids, load the pipe. The pipe is unloaded along the line at stations from 300 to 700 ft. apart and four men are required to unload the pipe and distribute it between stations by rolling. The contractor for the pipe line is P. J. Moran and the engineering work is handled under the direction of Sylvester Q. Cannon, city engineer.

Wall Form Saves Labor and Lumber

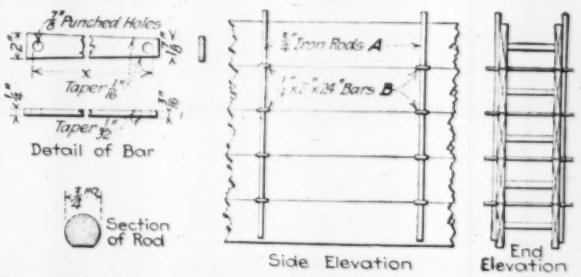
BY F. W. HODSON

Inspection Engineer, Sinclair Refining Co., East Chicago, Ind.

THE life of form lumber has been lengthened and labor has been reduced in erecting and dismantling wall forms by adopting the construction indicated by the drawings. This construction is not original with the company but it has been found exceptionally useful in recent construction.

The material required consists of: 2 x 12-in. planks, ¼ x 2-in. steel straps, and ¾-in. diameter rods. The planks are notched ¼ in. deep by 2 in. long every 6 ft. on one edge. The straps are cut from ¼ x 2-in. steel in the length desired. They are then tapered ⅛ in. on each long edge and 3/32 in. on the flat faces on a grindstone. Two ¾-in. holes are punched on centers equal to the width of wall desired plus twice the thickness of the planks used plus the diameter of one hole. The rods are cut from ¾-in. round steel and are 7 ft. long. They are flattened on a grindstone about ⅛ in., as indicated by the drawing.

In erecting the forms the bottom planks are set on



FORM PLANKS FREED BY WITHDRAWING RODS

edge with the notched edges up. The steel straps *B* are placed in the notches and the rods *A* are inserted in the holes in the straps. The second layer of planks is then laid on top of the first with notched edges up and the straps are slid down over the rods into place. This is repeated until the desired height is reached. The rods are then turned so that the long diameter is parallel to the steel strap. In wrecking the rods are turned so the flat sides are next to the planks and are then pulled out. The planks can be readily removed. Then by tapping the smaller end of the steel straps lightly with a hammer they may be easily pulled from the opposite side. Staggering the planks and coating the straps with oil will facilitate removal. The holes left by the steel straps may be pointed up after completion.

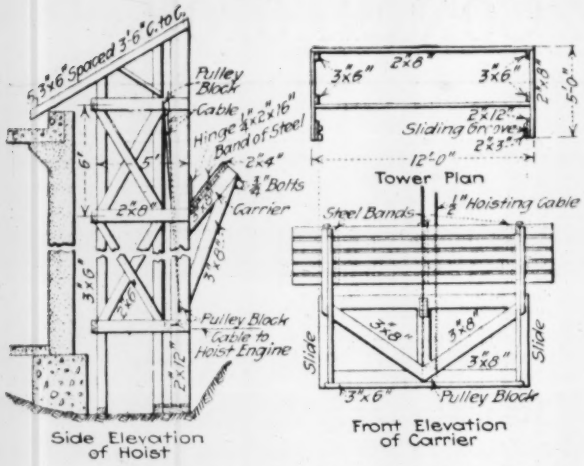
Steel and Lumber Hoist Equipment

THE horizontal struts of a small tower extended far enough to support 2 x 12-in. timbers form the skeleton of a hoist used for elevating steel and lumber to the various stories of a reinforced concrete factory building being constructed at Johnson City, N. Y., by Thompson & Binger, Inc., engineers and contractors, New York. The hoist was devised by C. M. Geupel, construction manager for the contractors.

The horizontal pieces of the tower support two 2 x 12-in. timbers upon which were placed vertically two pair of 2 x 3-in. pieces forming a groove in which the runners of the carrier slide. The runners of the carrier consists of 3 x 8-in. pieces, which form the sides of the carrier frame. Strap hinges are placed on the carrier, one end of which slides on the edge of the vertical 2 x 12-in. piece. When the carrier reaches the top of the tower this portion of the hinge falls down, releasing the bars from the carrier to the sloping 3 x 6-in. pieces on top of the tower, the bars rolling outside on these to the floor of the building. These flat iron bands placed on the platform of the carrier aid in the unloading.

The carrier, as indicated in the accompanying sketch, is elevated by means of a cable running over two pulley blocks, one placed at a point below the carrier platform so that when the carrier is hoisted to near the top pulley block the platform will have reached the top of the frame and will have automatically deposited its load.

Steel for the first supported floor was carried up a runway instead of being hoisted. For the remaining floors and the roof of the five-story building all rein-



DETAILS OF EASILY CONSTRUCTED MATERIAL HOIST

forcing steel was hoisted to the proper floor on this hoist. In addition the hoist was used for elevating form lumber, under-flooring or maple flooring and sleepers. Over 500 tons of reinforcing steel and 200,000 ft. of lumber were handled by the hoist.

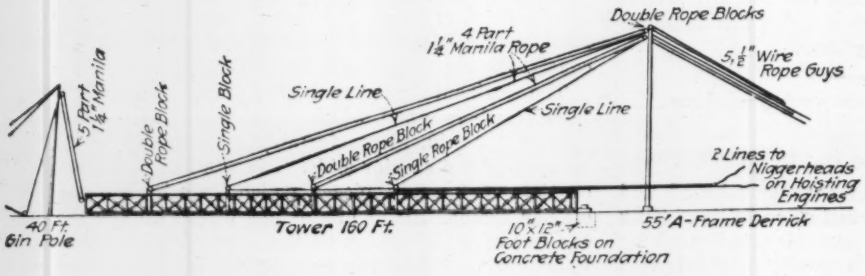
[Material for this article was secured from the *Contractors' Atlas.*]

Rigging for Raising a Concreting Tower

DETAILS of the method of rigging the tackle for raising intact the 160-ft. concrete chute towers for the new Dunlop Tire buildings at Buffalo, N. Y., by the Foundation Co. are given in a recent installation sheet of the Lakewood Engineering Co. This contractor has used the same method for towers as high as 200 ft. and finds some economy, due to the greater speed with which carpenters work on the ground and the difficulty of getting any but high-priced men to go up with a tower which is erected in place.

The towers in question were entirely completed on the ground, even to installing the catheads and top-sheaves and attaching the guys. They were nailed together, not bolted. Eight sets of diagonal braces were evenly distributed throughout the length of the tower on the inside to stiffen it during erection, but on future work it is planned to use oak corner posts on the lower section of the tower on the side which carries the erecting weight.

The method of rigging the tower is shown in the sketch. The hoisting blocks are attached with wire rope, several turns being taken around the entire tower. Two foot-blocks are fastened to the top of the concrete tower foundation to prevent the tower from slipping while being raised. The two main hoisting lines are carried to separate riggerheads on the hoist as the amount of pull required on the line varies.



RIGGING FOR RAISING A 160-FT. CONCRETING TOWER

The line to the gin pole may be handled by the same hoist, but in this case there was another hoist close at hand to which the line was run. The guy lines are attached to deadmen with blocks and tackle, and five or six laborers with a rigger as foreman are put on each line to take up or let out the slack as the tower goes up.

The upper end of the tower is raised about 35 ft. by the gin pole. Two main hoisting lines take up the slack up to this point. From this point on the main lines raise the tower to its vertical position. The line to the gin pole is not detached but acts as guy. Skillful manipulation of the hoist guy lines prevents any kinks from forming in the tower, and the body of the tower was kept straight all through erection.

On this particular job, from the time a tower was fully rigged on the ground until it was in its vertical position with the guys fastened varied from one hour and fifteen minutes to three hours.

Tractors Replace Teams for Scrapers

TWO 5-ton tractors, each hauling three wheeled scrapers, are used for grading work by the American Cement Plaster Co. at its plant at Acme, Tex. The scrapers are of 16 cu.ft. capacity and there are two men to each train, one operating the tractor and the other loading and dumping the scrapers.

Inability to get men who knew how to drive and care for teams, extremely high wages for drivers and high cost of feed were the main reasons for using tractors. The two tractors are doing as much work as twelve wheeler teams could do, according to C. H. Newby, superintendent for the company. When the first machine was purchased it was worked in competition with one of the best teams, the horses weighing 1,400 lb. each and handling a wheeled scraper without the aid of a snatch team. The tractor pulling three larger scrapers would make about four trips to three by the team, both having the same length of haul.

Four men, as above, are now handling as much material as was handled formerly by twelve men, which makes a saving of about 25 per cent, after taking both horses and engines into consideration. With a maximum haul of about 1,200 ft. the two machine outfits are moving about 400 cu.yd. per day. The excavation is 12 ft. in depth and the dump is on the surface of the ground, so that the machines run up hill and down hill all day. The tractors load the scrapers on low gear, haul them to the dump on direct gear and return to the pit on high gear when the ground is sufficiently level. Each machine uses an average of 25 gal. of gasoline per 10-hour day and about a gallon of lubricating oil, besides cup grease. The maintenance on the machines has been very small.

NEWS OF THE WEEK

New York, August 26, 1920

E. J. Mehren Returns from Europe

E. J. Mehren, editor of *Engineering News-Record*, returned to this country on the *Aquitania* Aug. 21, after a four-months' European trip devoted to a study of engineering conditions. He left the United States April 24 and after spending about a month in England visited France, Belgium, Switzerland, Germany and Holland. For several months this journal has been publishing Mr. Mehren's observations abroad in the form of special articles and also under the heading "Notes from Foreign Fields."

Hetch Hetchy Tunnel Work Let to Sub-Contractors

The entire 18 miles of Hetch Hetchy tunnels for the water supply of San Francisco, recently let to the Construction Company of North America, has just been sublet to two well known tunnel men. A. C. Dennis has contracted for 10 miles of the work on the west or Priest portal end and Rex C. Starr has the 8 miles on the Early Intake end.

Mr. Dennis, who has been practising as a consulting engineer for several years, was in personal charge of construction on the 5-mile Rogers Pass tunnel for the Canadian Pacific Railway, where exceptional progress records were made. Mr. Starr is construction engineer for the San Joaquin Light & Power Corporation and has had charge of construction work continuously for a number of years in which he has gained a reputation for speedy work in tunnel driving.

Joint Water Supply Proposed for Seven Cleveland Suburbs

The Suburban Water Commission, composed of the mayors of seven municipalities in Cuyahoga County, west of Cleveland, Ohio, has been organized, with E. A. Fisher, city engineer of Lakewood, as secretary. The communities other than the city of Lakewood are the villages of West Park, Rocky River, Fairview, North Olmsted, Dover and Bay. Lakewood and West Park now take water from the Cleveland works. Rocky Park has an independent supply which is inadequate in quantity and unsatisfactory in quality. The other villages have no public water supply. The seven municipalities, it is reported, feel that they can secure an adequate water supply by joint action sooner than if they wait for extensions of the Cleveland works. A report on the project is to be made by Morris Knowles, Inc.

Federated Societies Sentiment in Control At Civil Engineers' Convention

Portland Meeting Asks Quick Vote on Federation—Conference of Local Representatives Favored—Opposing Amendments Referred to Committee

PRO-FEDERATION sentiment was prominently in evidence at the annual convention of the American Society of Civil Engineers, held in Portland, Ore., Aug. 10 to 12, 1920. Those who held this sentiment proved to have the necessary voting strength to control the proceedings, and, accordingly, action on the five groups of amendments to the society's constitution, which had been proposed for discussion at the convention, was favorable to the federation. A resolution requesting the Board of Direction to issue at once a referendum ballot on the subject of joining the Federated American Engineering Societies expressed the attitude of the convention majority still more clearly.

The more radical amendments were ordered to letter ballot of the society either unchanged or with but minor modifications, while final action on others was delayed. The proposal to establish an annual conference of representatives of local sections, fathered by a Philadelphia group of members, some of whom had been known as strong federation men, was accepted by the meeting, and the representation of District No. 1 on the Board of Direction was cut sharply, though the original proposal to allow the district only two directors was changed to give it three, making a total of directors (other than officers and past presidents) of fifteen. On the other hand, the amendments proposed by the Questionnaire Committee, providing in a slightly different way for the nomination of officers by the local sections and omitting to establish an annual conference that would discuss the general welfare of the society, were referred to a committee of the Board of Direction, and they will, therefore, not come up for action until next January. Another proposal of this committee, however, was passed to immediate vote, this being an increase of membership dues with reduction of the extra dues paid by resident members. An independent amendment which would have raised the dues so as to abolish all extra charges to resident members was deferred by reference to a committee of the board.

Two individual amendments, one reforming the election of honorary members by requiring a favorable vote of two less than the total membership of the Board of Direction (in place of unanimous vote) and the other making the members of the nominating committee ineligible to office during service, were acted upon favorably, being passed to immediate letter ballot.

Discussion of the five groups of amendments (designated as A, B, C, D and E in *Engineering News-Record* of July 29, p. 235, where their provisions are summarized) was the principal business of the convention. To facilitate action upon them, the convention divided them into fourteen parts, the proposed amendments to each separate article being considered by themselves.

Address of President Davis

Before the work of the convention proceeded, President Arthur P. Davis delivered the annual address, after welcome had been given to the convention by the mayor of Portland, George L. Baker and by F. H. Murphy, secretary of the Oregon Technical Council, an organization consisting of the Portland sections of the civil engineers, the mechanical engineers, the electrical engineers, the architects and the National Electric Light Association.

President Davis sounded the keynote of the convention. His address was, in effect, a severe indictment of the "small, but very active minority" in the American Society of Civil Engineers, which, it was charged, opposed each and every step tending to coordination and co-operation of the Founder Societies. "The real issue in the contest now going on, and especially in the election of directors which will take place next fall," said Mr. Davis, "is whether or not the society is to take its proper place among human activities or gradually decay and become an obstruction to progress, pretending to fill a niche which it does not fill and wasting the prestige and history of this glorious society which ought to be devoted to some end more useful than individual benefits to a small circle of its membership."

President Davis asserted that Engineering Council is not a satisfactory organization for producing results, as

it lacks in democracy and in power to raise funds, and recommended the substitution of a league of engineering socieites. Referring to the plan of organizing such a society with individual membership, he pointed to the American Association of Engineers and expressed the view that it lacks the necessary prestige to become an all-inclusive society and attain the broader ends that have been aimed at in the federation movement. Under present conditions, he said, the countrywide demand for broader activity by the society cannot be met because of the existence of a strong conservative element in a few large cities, backed by an antiquated constitution. The main issues before the society were summarized as "progress versus stagnation, and democracy versus centralized domination."

Coming to other subjects, Mr. Davis expressed himself in favor of license laws and in favor of centralizing the engineering activities of the government in one department. License laws, if properly directed, he said, can be of great benefit.

The address of President Davis, practically in full, will be published in next week's issue.

Amendments Discussed

Following this stimulating address, the meeting referred the various constitutional amendments for digesting to a committee of five—George B. Mason, J. C. Ralston, Roger C. Rice, E. E. Wall and A. A. Northrup. This committee reported that six of the fourteen proposed amendments should be referred to a committee of the Board of Direction for revision and resubmission at the annual meeting of the society in January; the other eight were recommended for favorable action. The vote of the meeting was substantially in accordance with this recommendation.

In summary, four of the amendments were ordered sent to letter ballot in the form originally proposed, four were slightly revised and thereupon ordered sent to letter ballot, while six were referred to a committee of the Board of Direction for report at the annual meeting.

Passed to Ballot Unchanged—The amendments passed to letter ballot unchanged are:

Part of amendment B (see *Engineering News-Record*, July 29, 1920, p. 236), changing Art. I, Sec. 3, to broaden the stated objects of the society so as to include co-operation in economic, industrial and civic movements.

Part of amendment C, changing Art. III, Sec. 1, referring to election of honorary members by the Board of Direction so that two less than the total membership of the board will elect.

Part of amendments B, amending Art. IV, Secs. 2 and 3, so as to increase the dues of corporate members and associates by $5 and reduce the additional dues for resident members to $5 (except for associates).

Amendment D, changing Art. VII, Sec. 2, so as to make members of the Nominating Committee ineligible for election to office during service.

Amendments Modified by Convention—Detail changes were made in four of the proposed amendments as follows:

The local-section amendment in Group B, changing Art. II, Sec. 9, was modified by eliminating the last paragraph, which stated ways in which local sections would stimulate active interest of the members.

Decrease of the number of directors to fourteen, as proposed in one of amendments E, was modified by providing for fifteen directors, three (instead of two as proposed) representing District 1. A provision was also added that all officers of the society at the time of adopting the amendment should continue to serve out the term for which they were elected.

Nomination of officers at an annual conference of representatives of local sections, as proposed in another amendment of group E, was modified by providing in Sec. 3, for voting power in proportion to the memberships of the local sections, and requiring the secretary upon receipt of the report of the conference to notify the nominees and ascertain their acceptance or declination, the Board of Direction to fill vacancies caused by declinations.

In the Group E amendment establishing this annual conference (amendment to Art. VIII, Sec. 8), the principle of proportional voting was also added, and traveling expenses allowed to one representative from each section (instead of to all).

Referred to Committee of Board—Amendments affecting six sections of the constitution were put off until next January by being referred to a special committee of the Board of Direction. They are:

Abolition of the resident membership extra dues (Amendment A) by increasing the annual dues of members more than provided for in amendment B.

Nomination of officers by the local sections as proposed in three amendments of Group B conflicted with an amendment of Group E, already noted, by which the work of nomination was allotted to an annual conference of representatives of local sections. The provision of Amendments B was referred to a committee of the board.

Part of Amendment C relating to the election of honorary members proposed to strike out the clause of the present constitution which provides that all past presidents shall be members of the Board of Direction for the purpose of electing honorary members. This proposal was referred to the Board of Direction.

One of Amendments B providing for the establishment of local sections in a slightly different way from that provided for in Group E was also referred to the board.

Subsequently the following committee was appointed by the Board of Direction to consider the amendments referred back: Peter Junkersfeld, Boston; Paul H. Norcross, Atlanta; L. Hidinger, Memphis; J. F. Coleman, New Orleans; A. S. Baldwin, Chicago; L. Ash, Kansas City; E. J. Schneider, San Francisco; F. R. Fuller, Portland.

Convention Disagrees With Board

In a meeting held just before the convention the Board of Direction had decided to refer the legal questions involved in the society's joining the Federated American Engineering Societies to its legal counsel, and to issue a referendum ballot to the membership of the society only after receiving a favorable opinion from counsel. The convention took issue with this decision, however, by adopting the following resolution, moved by J. C. Ralston:

"First, that the action of the board relative to joining the Federated American Engineering Societies, taken at its meeting of Aug. 9, 1920, should be reconsidered;

"Second, that the board be directed to submit at once the question of the society's becoming a charter member of the Federated American Engineering Societies to referendum vote of the corporate membership as recommended by the Joint Conference Committee, the ballot to be accompanied by a copy of the constitution and bylaws of the Federation;

"Third, that the board be instructed in the event of a favorable vote on the referendum to proceed at once to take such steps as may be necessary for the society to become affiliated with the Federation."

At a subsequent meeting the Board of Direction took action substantially in accord with the view expressed in the resolution just quoted, as fully reported in these columns last week (Aug. 19, p. 380).

Various entertainment and special features marked the convention. About 400 members participated in a trip up the Columbia River Highway by automobile on Aug. 11, made under almost perfect weather conditions. Stops at several of the cascades along the road, a visit to the state fish hatchery at Bonneville, and a trout and salmon dinner at a long table under the trees on the shore of Eagle Creek were parts of the trip. A smoker was held the same evening, with participation of members of the Oregon Technical Council and of the American Association of Engineers. A harbor trip was made the following morning (Aug. 12) including visits to the municipal terminals, the Interstate Bridge, and the Standifer steel shipyard at Vancouver, Wash. Other parties visited the Cazadero power plants of the Portland Railway, Light & Power Co. and the Oregon City paper mill of the Hawley Pulp & Paper Co.

On the return trip from Portland, many of the convention visitors made stops at Seattle, Yakima, and Spokane, where local engineering delegations received and entertained them.

Competition Speeds Up Rate of Driving Kerckhoff Tunnels

In driving the tunnels for the Kerckhoff hydro-electric project, which was described on p. 314 of *Engineering News-Record*, Feb. 12, the contractors on different headings were encouraged to compete with one another. Prizes or bonuses were offered for the longest round pulled, the greatest progress on a weekly basis and the first hole through to the opposing side. The keenest competition occurred on the 8,400-ft. tangent of Tunnel No. 1, which could be worked from the two portals only, and which was the controlling factor in the completion of the entire project.

The tunnels were started and holed through in the following order: On July 9, 1920, South Portal, or Tunnel No. 4 (started Aug. 25, 1919) holed through into Tunnel No. 3 South (started July 27, 1919). Tunnel No. 4 drove a distance of 3,282 ft. and Tunnel No. 3 South, a distance of 2,901 ft.

On July 9, 1920, Tunnel No. 3 North (started Aug. 23, 1919) holed through into a 7-ft. x 17-ft. heading which was started south from Adit No. 1 on April 27, 1920. The crew in Tunnel No. 3 North removed the bench in Adit No. 1 South, finishing a total of 3,144 ft. on July 23, 1920.

Tunnel No. 1, or North Portal (started June 6, 1919) and tunnel No. 2, or Adit No. 1 (started June 30, 1919) holed through on the night of July 27, 1920, after an interesting race between crews, thus completing the 8,400-ft. tangent. The record for distance in the last eight days on this tunnel was closely contested, the North Portal crew driving in this time 125 ft., an average of 15.63 ft. per day, and Adit No. 1 crew pushing them hard with 123 ft., or an average of 15.38 ft. per day. The record pull, or break, jumped from one crew to the other. The North Portal, on July 21, made a pull of 18.3 ft., followed on July 25 by a pull of 18.8 ft. from Adit No. 1. The North Portal crew were not to be outdone and on the same night made a pull of 19.3 feet.

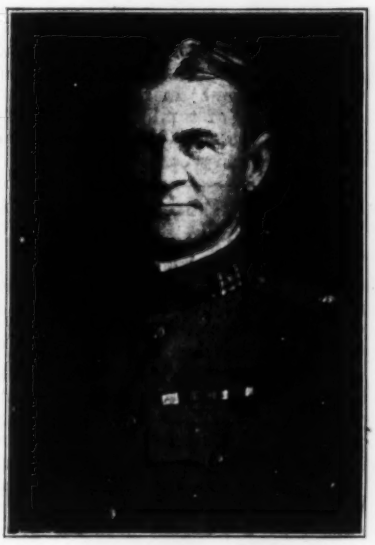
These measurements were checked by an engineer not particularly connected with the tunnel work so that no partiality could be claimed by either crew. The North Portal crew also won the honor of driving the first drill hole through to the opposing side. North Portal drove a total distance of 4,038 ft. and Adit No. 1 a total distance of 4,370 ft.

These records for long breaks in a 17-ft. x 17-ft. tunnel and the record made by the crew in Adit No. 1 by driving 1,343 ft. in three months, March, April and May, are believed by the company's engineers to constitute "if not a world's record, at least a record for the United States which will be hard to beat."

Rex C. Starr, construction engineer for the San Joaquin Light & Power Co., was in charge of the work from its inception.

Col. Walker to Command Engineer School at Camp Humphreys

The important assignment as commander of Camp Humphreys and commandant of its engineer school has been given to Colonel Merriweather L. Walker. During the war Colonel Walker was a brigadier-general overseas, where he was director of the Motor Transport Corps. Since his return to this country, he has served as instructor at the General Staff College, and at the time of this last appointment he was serving as division engineer at Cincinnati.



COL. M. L. WALKER

Ohio To Speed Federal-Aid Highway Work

Following the return of Highway Commissioner A. R. Taylor and Senator W. A. Alsdorf, secretary of the Ohio Good Roads Federation, from a trip to Washington, where they were in conference with officials of the Bureau of Public Roads, it was announced that all Federal-Aid projects in Ohio had been approved and that work upon them would go forward. This will mean the award of a large number of road improvement contracts during the remainder of the year.

16-Story Concrete Office Building for New York

A reinforced concrete building 16 stories high is to be built in the leather district of New York City, just below Brooklyn Bridge. This is a record height for such a structure on Manhattan Island, where concrete has been used sparingly and only for lofts and factories. The new building is to be at the corner of Gold and Frankfort Streets, on a plot 69 x 74 ft., and will be 189 ft. high. It is to be built for the Hide & Leather Realty Co., Inc., by Thompson Binger, Inc., as general contractor.

Chicago to Begin Lake Front Work

As a first step in creating the new lake-front park in Chicago, which is to be formed by filling along the present shore line south of Twelfth St., the South Park Commissioners have decided to place contracts for a section of the bulkhead wall which eventually will form the west bank of the inner waterway or lagoon (see *Engineering News-Record*, Aug. 21, 1919, p. 360). This section will extend south to Twenty-fourth St. The bulkhead will be of wood piles and rock filling, capped with a concrete wall in some parts. At other parts the bulkhead will be cut off near the water line, after the filling has been placed, the shore being dressed to a flat slope and finished with earth or riprap. With the construction of this first section of bulkhead there will be an enclosed space for depositing the city waste and rubbish as filling, which material averages from 750,000 to 1,000,000 cu.yd. annually. The work is under the direction of Linn White, chief engineer for the South Park Commissioners.

Port Authorities Will Meet

Announcement has just been made that the American Association of Port Authorities will hold its annual convention in Chicago, Oct. 4, 5 and 6, 1920. Special attention at the meeting will be paid to the port and harbor problems of the Middle West, and the Great Lakes and St. Lawrence River Navigation projects. Among the papers to be presented are descriptions of the new port works at Vancouver, Portland, Ore., and Toronto.

Indiana Road Contractors Use Liberty Bonds as Deposits

Road and street contractors of Indiana are making profitable use of Liberty Bonds instead of cash as deposits to guarantee their work. Under the Indiana law all street and road work that is done under the so-called Barrett law, a law providing that the property owner abutting the improvement may be allowed twenty years in which to pay for the improvement, shall be accompanied by a 10 per cent deposit on the part of the contractor to insure the guarantee of the improvement and to insure his making any repairs needed during the life of the guarantee.

In former years the contractors generally deposited cash. This year they are buying Liberty Bonds, which have been about fifteen points below par for the past several months, and are depositing them as security on the completed contracts. Regularly they go to the city or county treasurer's office and clip their coupons. They expect the bonds to reach par at the expiration of the five-year period which, according to law, the securities must be held. Incidently the different municipalities are being deprived of considerable interest on the money formerly deposited.

Gen. Carson Heads Construction Service of Q. M. Corps

Brigadier General J. M. Carson has been placed in charge of the construction service, now a part of the Quartermaster Corps of the Army Much of his term of service has been spent in constructional activities, including practically all of the newer buildings at the U. S. Military Academy at West Point.

General Carson was born in Pennsylvania, June 26, 1864. He was graduated from West Point in 1885 and was immediately put on construction duty. He was engaged in building operations at Fort Hamilton, N. Y., until the war with Spain. From the close of that war until 1903, he was in charge of construction and repair activities for the Quartermaster Corps. He spent the next eight years on the building construction work at West Point.

In 1911, General Carson was sent to the Philippines to take charge of construction, other than fortification work, on Corregidor Island. During the three years that he was engaged in that work, he disbursed $8,000,000. In addition to the erection of the necessary buildings, he put in the water and sewerage systems and built the necessary streets and roads.

Having reached the grade of colonel, in 1914, he was ordered to depot duty and was assigned to the New York depot. In 1917, in addition to his duties as depot quartermaster at New York, he was charged with preparing plans for handling the embarkation of troops at that port.

In November, 1917, General Carson was sent to France as chief quartermaster of the line of communications. He served in that capacity until March, 1918, when he became deputy chief quartermaster of the A. E. F. With the return of General Rogers to the United States, in January, 1919, General Carson became chief quartermaster of the American forces in France. On Sept. 1, 1919, he was made zone supply officer at New York and, in addition, since January, 1920, served as depot quartermaster at New York, which post he is relinquishing to become chief of the construction service.

Four Divisions for General Staff

Under the provisions of the Army Reorganization bill, the General Staff has been reorganized and will include four divisions, as follows: Operations; military intelligence; war plans; and supply. The military intelligence division, in which civil engineers are most interested, is charged with the collection, evaluation and dissemination of military information for the use of the Secretary of War, the Chief of Staff and the War Department General Staff. It is specifically charged with (a) formulation of policies with reference to military topographical surveys and maps, including their reproduction and distribution; (b) supervision and training of military attaches, observers and foreign language students; (c) formulation of policies affecting the supervision of intelligence personnel for all units; (d) use of codes and ciphers; (e) translation of foreign documents; (f) establishment and maintenance of contact with other intelligence agencies of the government and with duly accredited foreign military attaches and military missions; (g) construction and reproduction of special maps required for intelligence purposes, including the procuring of maps from foreign sources; (h) custody of the General Staff map and photograph collection. In the event of the establishment of a military censorship, the director of this division shall act as chief military censor.

Kerckhoff Hydro-Electric Plant Put in Service

The 50,000-hp. Kerckhoff hydro-electric plant has been completed by the San Joaquin Light & Power Co., and was put in service on the generating system of that company on Aug. 15. This plant, on which work has been rushed from start to finish, was completed in a 15-month construction period, 60 days ahead of schedule, and is said to be the first hydro-electric project to be started and finished since the war was over. The haste was caused by the urgent need for power on the San Joaquin Valley, which will be somewhat relieved by this additional block.

Electrical Engineers Join Federation

At the meeting of the Board of Directors of the American Institute of Electrical Engineers held in New York Aug. 12, 1920, the following resolution to become a charter member of the Federated American Engineering Societies was unanimously adopted.

> *"Resolved,* That the American Institute of Electrical Engineers accepts the invitation to it to become a Charter Member of the Federated American Engineering Societies, and pledges its hearty co-operation in the work thereof."

Federal Power Commission Busy on Regulations

After having heard criticisms and suggestions at two public hearings, officials of the Federal Power Commission and a committee appointed by outside interests are engaged in whipping into final shape the rules and regulations for use in connection with the waterpower act. The principal changes which have been agreed upon eliminate much detail from the information required with the application. It is believed that this data can be furnished more intelligently when the project will have been completed. Financial interests have asked those drafting the regulations not to add to the hardships already imposed by the law.

Detail of Regimental and Coast Defense Commanders

The War Department has instructed the Chiefs of Infantry, Cavalry, Field Artillery, Coast Artillery and Engineers that with a view of development and maintenance of the highest efficiency among combat regiments and coast defense commands of the Army the policy will be that regimental and coast defense commanders who are rated as "superior" and "above the average" will be retained with their commands for a tour of duty of at least two years and will not be changed except for exceptional reasons.

Activities of the A. A. E.

The San Diego Chapter has elected the following officers: President, George F. Hayler; vice-president, Fred Grumm; recording secretary, V. Elmendorf; treasurer, S. A. Evans; member of executive committee, George Cromwell.

The Nevada Chapter has elected the following officers: President, H. M. Loy; first vice-president, H. F. Holley; second vice-president, G. W. Borden; third vice-president, C. C. Cottrell; corresponding secretary, L. V. Campbell; recording secretary, Dale B. Pruett; treasurer, H. M. Payne.

The San Francisco Chapter, at its July meeting, was addressed by Prof. C. D. Marx, head of the Department of Civil Engineering at Stanford University, who explained the proposed National Department of Public Works and gave a progress report of what has been done to promote this new department. Walter D. Cole, manager of the Marchant Calculating Machine Co. and president of the Oakland Chamber of Commerce, was the speaker at the August meeting. His subject was "The Relation of the Chapter to Civic Organizations."

The Akron Chapter, at its meeting of Aug. 17, was addressed by Senator F. E. Whittemore, of Ohio, who introduced Hon. Carl H. Kimball, Speaker of the State House of Representatives. Mr. Kimball spoke on "The Engineer in Politics." L. E. Barkheims, formerly of the 29th Engineers, A. E. F., gave a talk on "Sound Ranging in France," illustrated with specially drawn diagrams. H. G. McGee, acting president of the chapter, explained some charts which he had prepared showing graphically the present financial and economic conditions in the United States and Europe with relation to conditions following the Civil War.

Columbia Starts 3-Year Course in Industrial Engineering

A three-year course leading to the degree of master of science and industrial engineering has been organized at Columbia University according to the announcement of Dean George B.

Pegram of the School of Mines, Engineering and Chemistry. It is not intended that the new course constitute a short cut to professional success but rather afford a rigid training to meet what is described as a very general need and growing demand for executives of manufacturing and other industrial and commercial enterprises who are instructed in both engineering and business principles and practices. The departmental representative for the course will be Prof. Walter Rautenstrauch.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for Form 1312.

Junior Civil Engineer, Bureau of Public Roads, $1,500 a year. File application not later than Sept. 28.

Canada

Application forms may be obtained from the office of the Employment Service of Canada, or from the Secretary of the Civil Service Commission, Ottawa.

Assistant to Director of Technical Education, $3,480 to $3,840 a year. File application not later than Sept. 3.

Bridge and Structural Engineer, $2,820 to $3,420 a year. File application not later than Aug. 31.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Holyoke, Mass., Sept. 7-10.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

SOUTHWEST WATER WORKS ASSOCIATION, Waco, Tex.; New Orleans, La., Sept, 20-23.

AMERICAN ASSOCIATION OF PORT AUTHORITIES, Montreal; Chicago, Sept. 30-Oct. 2.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; St. Louis, Oct. 10-15.

The Duluth (Minn.) Engineers' Club, at its annual meeting Aug. 2, received the report of its committee appointed to investigate the question whether or not the club should become a member of the Federated American Engineering Societies. The decision of the committee was that further study by the club membership was advisable and that several points should be investigated and cleared up. The report was accepted, the committee discharged and the secretary instructed to get the information desired.

PERSONAL NOTES

A. N. JOHNSON has severed his connection with the Portland Cement Association to assume his new duties as dean of the Engineering School of the University of Maryland and director of engineering research. The latter work is to be particularly along lines of highway construction and engineering, in co-operation with the U. S. Bureau of Public Roads and the State Highway Department of Maryland.

JOHN W. MEREDITH has been appointed city engineer of Antioch, Cal., succeeding R. P. Easler, who has resigned to become manager of the West Coast Dredging Co., with offices in Antioch.

LEROY K. SHERMAN, who recently resigned as president of the U. S. Housing Corporation, has been made vice-president of the Edmund T. Perkins Engineering Co., Chicago.

COL. EDWARD WALTON has been placed in charge of the district office for the Eastern District of the U. S. Construction Service, with headquarters at Washington, D. C.

CLARENCE E. RIDLEY, city engineer of Port Arthur, Tex., has tendered his resignation. He will go to New York to take an eight months' course in the New York School of Public Service. Mr. Ridley was selected from a long list of candidates as one of those to take the course. Under his supervision Port Arthur has just finished a street improvement campaign costing in excess of $200,000. He will specialize in public administration and city management in his studies.

JAMES W. ROUTH, director and chief engineer, Rochester Bureau of Municipal Research, Inc., announces that he is available for service as consulting municipal engineer and is prepared to conduct investigations, prepare plans, specifications and reports, and supervise operations in connection with all municipal engineering activities. Special service can be rendered municipalities interested in improving the organization and administrative procedure of their departments of government.

CHARLES E. SIFFERLEN, junior engineer assigned to the valuation of the street railway system of Syracuse in the prospective adjustment of city car fares, has been made instructor in forest engineering at the New York State College of Forestry at Syracuse, N. Y.

WALTER E. MILLER has resigned from the staff of the Railroad Commission of Wisconsin, with which he was connected for nearly fourteen years, to engage in private practice as a consulting engineer. His practice will include investigations and studies of steam and electric railway and public utility problems, especially the valuation of such properties, rate-making therefor, reports on efficiency of operation, designing, estimating and supervising construction of new properties and improvements of existing plants. His office, temporarily, is in the Pioneer Block, Madison, Wis.

ARTHUR H. BLANCHARD, professor of highway engineering and highway transport at the University of Michigan, has recently been appointed consulting engineer to the Michigan State Highway Department.

J. R. MCDERMOTT has resigned as assistant highway engineer of Harrison County, Ohio, to accept a position with the West Virginia State Road Commission as assistant division engineer, with headquarters at Keyser, W. Va.

B. B. MILNER has tendered his resignation, soon to become effective, as engineer of motive power and rolling stock of the New York Central R.R., at New York City. He will go to Tokio to take a similar position with a Japanese concern.

BRIGADIER GENERAL C. H. MITCHELL, consulting engineer, Toronto, has been made a member of the commission of the Ontario Government appointed to investigate the hydro-radial situation.

A. F. MACALLUM, commissioner of works of Ottawa, has been made a member of the Ontario Government's commission appointed to investigate the hydro-radial situation.

CAPTAIN W. S. LAWSON, formerly a member of the Militia Headquarters Staff, Ottawa, is now inspecting bridge engineer of the Canadian Northern Ry., Eastern Lines, covering the territory between Port Arthur and Lake St. John.

N. W. MCCALLUM, electrical supervisor of bridges and buildings of the New York Central R.R., at New York, has been promoted to the position of division engineer, with headquarters at Oswego, N. Y.

S. H. BONAR has been appointed city engineer of Moundsville, W. Va.

THE MCCLURE, GREENE ENGINEERING CO. has been organized at Worcester, Mass., by FREDERICK A. MCCLURE, former city engineer of Worcester; EARLE W. GREENE, who was engaged by Mr. McClure while city engineer to assist him in the preparation of plans for the Imhoff sewer purification plant to be built by the city at a cost of $2,000,000, and who recently resigned to join Mr. McClure, and GEORGE M. WRIGHT, former mayor and former head of the Wright Wire Co., now merged with the Wickwire-Spencer Steel Corp. The firm will specialize in municipal engineering, including the designing and building of water-works, sewers, sewage disposal

plants, street paving, concrete construction, bridges, dams, hydro-electric development. This branch of the work, as well as general consulting engineering, will be under the direct supervision of Mr. McClure. Mr. Wright will have charge of the department of designing, wire mills, heating and annealing furnaces and the supervision of the building and the installation of the same.

A. E. DYATT has been appointed resident engineer of Kansas Federal Aid Project 7 in Douglas County, with headquarters in Lawrence, Kan., succeeding A. C. Lagerwall, resigned. For the past year Mr. Dyatt has been chief engineer of the Kansas Engineering Co., of Topeka, Kan.

OBITUARY

R. E. HARWOOD, civil engineer and contractor, for the past thirty years engaged in road construction in the South, died at Springfield, Ohio, his birthplace, Aug. 4, at 63 years of age.

SAMUEL MITCHELL, contractor, of Ottawa, Ont., died Aug. 13, in that city. He had lived in Ottawa for about forty years and most of that time was in the contracting business.

ROBERT PARKER STAATS, president of R. P. & J. K. Staats, building contractors, of New York City, died Aug. 8, at Great Barrington, Mass. He was 69 years old and a descendant of one of the first Dutch families in New Amsterdam. His firm has built many of the largest piers in New York Harbor.

N. F. THOMPSON, district engineer of the Western District of the New York Central R.R., at Buffalo, N. Y., died July 26, at Roswell, N. M. He was born at Lansingburgh (now Troy), N. Y., Oct. 16, 1884. He graduated in civil engineering from Rensselaer Polytechnic Institute in 1907 and soon afterward entered the service of the New York Central as draftsman in its engineering department. He was subsequently made assistant engineer of grade crossings and, in 1912, appointed engineer of grade crossings. He was made district engineer of the Middle District in March, 1917, with headquarters at Albany, N. Y., and was transferred to the Western District in January, 1918.

AARON H. WRIGHT, engaged for more than 70 years in bridge and railroad construction in New England, died at Springfield, Mass., Aug. 16, at 89 years of age. He was born in Norwich (now Huntington), Mass. Mr. Wright was for years associated with the late Daniel L. Harris of Springfield in the firm of Harris & Wright, bridge builders, and before Civil War days was engaged in railroad work in Tennessee. He was later associated with the late George F. Lyons, of Greenfield, and his son, Herbert W. Wright, under the firm name of Wright, Lyons & Co., in a general railroad contracting business. On the death of Mr. Lyons the business was continued under the name of A. H. Wright & Son until 1906, when Mr. Wright retired.

BRIG. GEN. CHARLES RUSSELL SUTER, U. S. Army, retired, died at Brookline, Mass., Aug. 7, at 78 years of age. He was born in Brooklyn, N. Y. and graduated from the U. S. Military Academy in 1862. He was commissioned in the Corps of Engineers, U. S. Army, and remained in the corps throughout his active life. During the Civil War he served with the Army of the Potomac, at the siege of Charleston, S. C., and elsewhere in the South. After the war he was assigned to the work of the improvement of the Mississippi River and its tributaries, stationed at St. Paul, Cincinnati and, for many years, at St. Louis. He was an original member of the Mississippi River Commission (1879 to 1896) and the first president of the Missouri River Commission (1884 to 1896). In 1896 he went to San Francisco as division engineer of the Pacific Division and president of the California Debris Commission. He was in charge of fortification and river and harbor work in the vicinity of Boston, from 1898 to 1901, and division engineer of the North Eastern Division and president of the Board of Engineers and of the board to report on the harbor lines of New York Harbor and adjacent waters, with station in New York, from 1901 to 1906. He was retired, by operation of law, as a brigadier-general, May 5, 1906.

BUSINESS NOTES

THE SHOURDS-STONER CO., INC., architects and engineers, Terre Haute, Ind., announces the opening of an office at Chicago. The Terre Haute office will be retained. The company maintains separate departments in architecture, and civil, mining, mechanical electrical and structural engineering, as well as an appraisal and valuation department.

EXUM M. HAAS, railroad specialist, has been appointed manager of the railroad department of the H. K. Ferguson Co., Cleveland. From 1912 to 1917 he was Western editor of the *Electric Railway Journal*, and for the past three years sales engineer for the Austin Co.

THE T. L. SMITH CO., Chicago, has opened an office and warehouse, through its agents, Norman B. Livermore & Co., at San Francisco, Cal. A complete stock of Smith tilting and non-tilting mixers, paving mixers, excavators and loaders, pumps, engines and boilers will be carried there, as well as a stock of repair parts, for immediate shipment to the company's agencies in Western territory. R. Bowen has been appointed Eastern district manager, in charge of the company's offices and warehouse at New York, succeeding W. S. Walker, who has resigned to take up other work in the Middle West. Mr. Bowen was formerly associated as sales manager with the Worthington Pump Co., the Allis-Chalmers Co. and the Prescott Steam Pump Co.

THE PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., announces the opening of additional sales offices in the following cities: Buffalo, J. B. Baird, manager; Cleveland, agent, L. J. Wakefield; St. Louis, agent, Corby Supply Co.; Minneapolis and Omaha, agent, L. E. Pollard Co.

G. BRONSON PHILHOWER, JR., during the war attached to the aviation and submarine chaser divisions of the Mechanical Division of the Navy, and since February of this year an apprentice in the various plants of the Reading Iron Co., has been appointed salesman in the company's railroad sales department, with headquarters at the New York office.

THE H. K. FERGUSON CO., Cleveland, has appointed MAJOR RICHARD W. ALGER manager of its Southern department, with headquarters at Atlanta, Ga. Previous to the war he practiced architectural engineering in Chattanooga, Tenn. During the war he was detailed to the Construction Division of the Army, from which commission he resigned in March of this year to become assistant chief engineer of the Ferguson Co. CAPTAIN RICHARD E. J. SUMMERS, who has been with the company since December, 1919, has been appointed assistant chief engineer. He was formerly with McClintic-Marshall Co., Pittsburgh. During the war he served for nearly a year as engineer officer in responsible charge of all construction in the Western Division of Great Gievres Depot for the A. E. F.

Telescoping Concrete Pile Forms

A patent (U. S. 1,342,424) has been issued S. M. Cotten, of Phoenix, Ariz., on a telescoping steel form for cast-in-place concrete piles. The form consists of a driving point, and a central driving shaft, with nested shells of diminishing diameter. In driving, lugs on the outside of the outer shell stop that shell at a determined depth and the impact of driving shears pins which hold the next smaller shell, so that the whole form continues to descend with smaller diameter shells successively taking their position. The advantage claimed is the reduction in skin friction due to the fact that only one section is ever in driving contact with the ground at one time.